ILLINOIS TECH

Engineer

OCTOBER, 1948

WATCH THAT WING!
Daring BETTY SKELTON calls it "precision flying"—but few men would try it!
LOOK AT THAT! A SLOW ROLL ON THE TAKE-OFF!
THEY SAY SHE'S THE ONLY WOMAN WHO DOES THAT TRICK—AND I DON'T WONDER!
I CAN JUST MAKE OUT THE RIBBONS. WELL—HERE GOES!
BETTY SKELTON'S TOUGHEST STUNT—USING HER WING TIP TO PICK UP TWO SILK RIBBONS—500 FEET APART—EACH STRETCHED BETWEEN TWO POLES, ONLY TEN FEET ABOVE THE GROUND!
SPEED: 130 MILES PER HOUR. ALTITUDE: 10 FEET!
THERE! I GOT THE FIRST RIBBON! NOW IF THE WIND WILL JUST STAY DEAD...
"EXPERIENCE IS THE BEST TEACHER!" SAYS BETTY SKELTON, "IN PRECISION FLYING... AND IN CHOOSING A CIGARETTE, TOO!"
WITH BETTY—AND MILLIONS OF OTHER SMOKERS—CAMELS ARE THE "CHOICE OF EXPERIENCE."
WHEW! CLEAR ACROSS THE FIELD—ONLY TEN FEET OFF THE GROUND!
NOW SHE'S SCOOPING UP THE SECOND RIBBON WITH HER OTHER WING TIP. WHAT A GIRL!
AH—A CAMEL! I SEE YOU KNOW YOUR CIGARETTES—AS WELL AS YOUR FLYING!
I LEARNED FROM EXPERIENCE THERE'S NO OTHER CIGARETTE LIKE A CAMEL!
I COMPARED MANY DIFFERENT BRANDS. COOL, MILD CAMELS SUIT ME TO A 'T'
Betty Skelton
Let your "T-Zone" tell you why!
T for Taste... T for Throat...
that's your proving ground for any cigarette. See if Camels don't suit your "T-Zone" to a "T."
R. J. Reynolds Tobacco Co., Winston-Salem, N. C.
According to a Nationwide survey: MORE DOCTORS SMOKE CAMELS THAN ANY OTHER CIGARETTE
Three nationally known independent research organizations asked 113,597 doctors to name the cigarette they smoked. More doctors named Camel than any other brand.
MORE PEOPLE ARE SMOKING CAMELS THAN EVER BEFORE
CAMEL
TURKISH & DOMESTIC BLEND CIGARETTES
CHOICE QUALITY
THE CHOICE OF EXPERIENCE

VOLUME 14 NUMBER 1 OCTOBER, 1948

Contributors . . . . .

Milton E. Parker, professor in charge of the food technology program, joined the Illinois Tech staff in April of this year. A native of Massachusetts, he was graduated in industrial biology at Massachusetts Institute of Technology in 1923. He was dairy technologist in the Baltimore Research laboratory of the National Dairy Products corporation for several years and later was quality supervisor in the Danville, Ill., plant of the same concern. From 1936 to 1944 he was manager of production for the Beatrice Foods company in Chicago, and from 1944 until his Illinois Tech appointment he was a private food technologist.

Joanne Starr Malkus, instructor of physics and meteorology at Illinois Tech, received her bachelor's and master's degrees at the University of Chicago in 1943 and 1945, respectively, and is now a candidate for a doctor of philosophy degree at that institution. Mrs. Malkus has served at the Chicago Airport on a United States Weather Bureau in-station program and was an instructor in meteorology at New York university from June, 1943, to March, 1944. She has been with Illinois Tech since September, 1947. She is a member of Phi Beta Kappa and the American Meteorologist Society.

Friedrick K. Richter, associate professor of foreign languages and literature at Illinois Tech, spent his early life in Germany and received the degree of doctor of philosophy at Breslau university, Bonn, Germany. Dr. Richter came to this country in 1937 and in 1941 joined the Illinois Tech staff. He is also a painter, and a number of his works have been exhibited in the United States and Europe. He has worked in the field of race relations, and in *(Please turn to page 4)*

Cover Picture: Looking north along a shaded walk between Illinois Tech's new Chemistry building (left) and Metallurgical and Chemical Engineering building (right). A third new building, Alumni Memorial hall, is seen in the background.

ILLINOIS TECH Engineer

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Published October, December, March and May
Subscription rates, $1.50 per year.
Editorial and Business Office, Illinois Institute of Technology, 3300 Federal St., Chicago 16, Illinois.

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1944 he received the distinguished interracial cooperation service award. At one time Dr. Richter served as assistant editor of *ETC.: A Review of General Semantics.* An article by Dr. Richter, "German Publications Since the End of the War", appeared in the October, 1946, issue of the *Illinois Tech Engineer.*

Frederick W. Jauch, assistant director of public relations, handles athletic publicity for Illinois Tech. He attended the University of Illinois for three years prior to his service in the Army Air Forces from 1943 to 1946. He returned to Illinois after the war, receiving a bachelor of arts degree in English literature in 1946. He did graduate work in English literature for another year at Illinois before joining the Illinois Tech staff in August, 1947. He edits the *Technometer,* alumni publication, and is an associate editor of the *Illinois Tech Engineer.* Mr. Jauch has had poetry published in *Tomorrow,* national literary magazine.

Roy C. Newton has been vice-president in charge of scientific research at Swift and Company, Chicago, since 1941. Prior to that he was with the same company as chief chemist for 10 years. After service overseas in World War I, Dr. Newton took a bachelor's degree at Oklahoma A & M. He taught at Oklahoma A & M, Purdue, and Lewis Institute, and joined the research staff of Swift and Company in 1924. He received his doctorate in chemistry at the University of Chicago in the same year. He is past president of the Institute of Food Technologists and former chairman of the Chicago section of the American Chemical Society. This year he won the Honor Scroll award of the American Institute of Chemists, Chicago section.

Earl C. Kubicek, executive secretary of the Alumni Association and director of alumni relations, has done considerable study on the life and works of Mark Twain. He is even more of an authority, however, on Abraham Lincoln. His immense collection on Lincoln contains more than 500 volumes, including some rare and valuable pieces. "The Engineering Mind of Abraham
(Please turn to page 58)

Food Technology Comes Into Its Own—

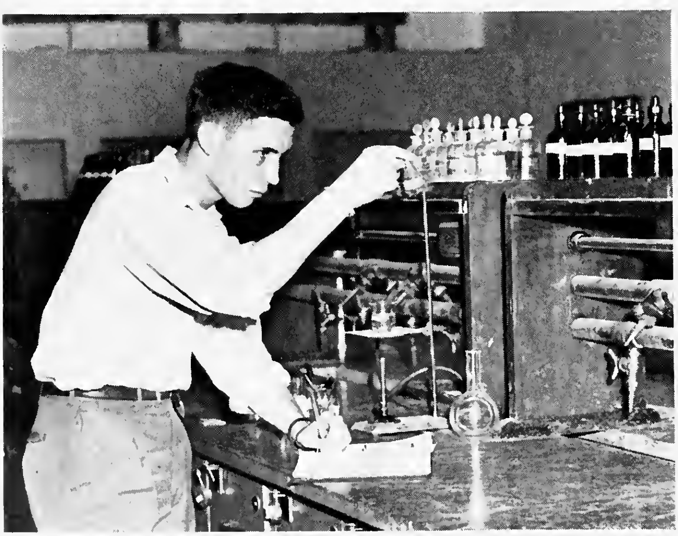
by MILTON E. PARKER*

FOOD technology, as a profession, is just beginning to come into its own. The future of the world's oldest and largest business — the processing, handling and distribution of food — is becoming more and more dependent upon science and its applications. This means, of course, that the men holding future responsible positions in American food companies are most likely to be those with the technical training that will enable them to cope with the problems they must meet and solve.

Oddly enough, due to its very age and ubiquity, the food business was, up to the early years of the 1920s, composed of many unrelated processing plants without any means or desire of having contact with each other. A baker was a baker — a brewer, a brewer. All had their secrets, generally of the particular art—and job—each was endeavoring to isolate and protect. There was little if any appreciation of the basic methods of processing and incidental equipment that actually tied them all together.

It was perhaps the advance in industrial microbiology and the development of chemical engineering that brought about a revolutionary change in the age-old philosophies of the buttermaker, the canner and the other thousand and one job classifications of food industries. Their "arts" began to give way under an impetus created by the thinking that all chemical processes, regardless of end-product, have many similar operations. Such realization came from the observations that the processing of food is similar to chemical processing in many basic operations.

*Professor in charge of the food technology program at Illinois Institute of Technology.



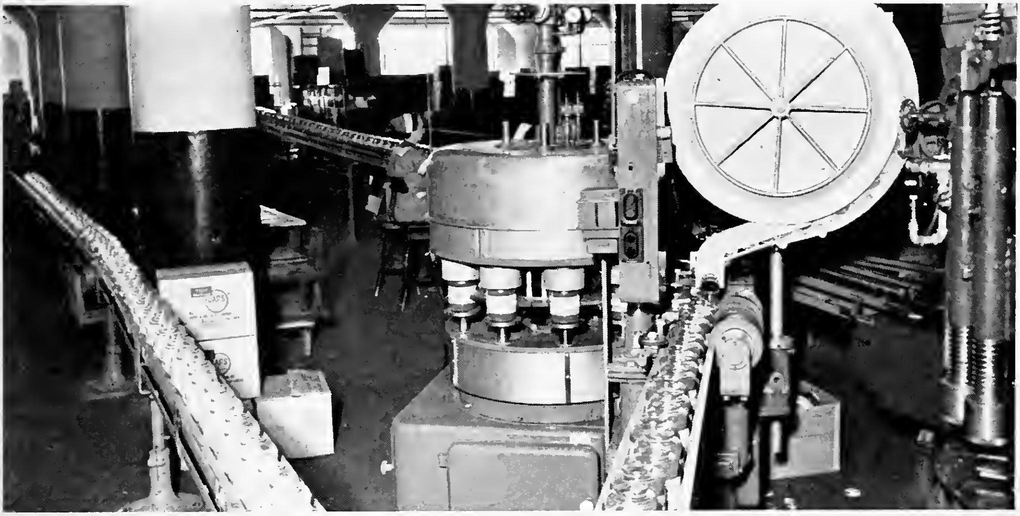
A student in food technology at Illinois Tech conducts an experiment in the chemistry laboratory. A knowledge of chemistry is essential to the professional food technologist.

The First Food Technology Conference

In the first Food Technology Conference ever held in the United States —at Massachusetts Institute of Technology in 1937—Dr. L. V. Burton, editor of *Food Industries*, called attention to the fact that "the unit operations in food engineering group themselves naturally into 15 different classifications," although he found that there were at least 107 different names that could be applied to these basic operations. True, also, the number of subsidiary names applicable to one unit operation can prove substantial; for example, he listed 23 names that could be grouped under the one unit operation of *separating*.

While the first Food Technology Conference in 1937 served to bring together a substantial group of individuals who considered themselves "food technologists," the beginnings of the profession were earlier apparent to Dr. S. C. Prescott, for in the 1922 M.I.T. catalogue a statement was made offering an option in a group of subjects labelled "Food Technology". It is interesting to also note that one of the leading food technologists of the United States—Thomas M. Rector, vice president of the General Foods Corporation—had a vision as a young

...nd to Technology Center



Innumerable coffee jars are filled at the Chase and Sanborn plant.

man, of this new profession then forming. To use his own words:

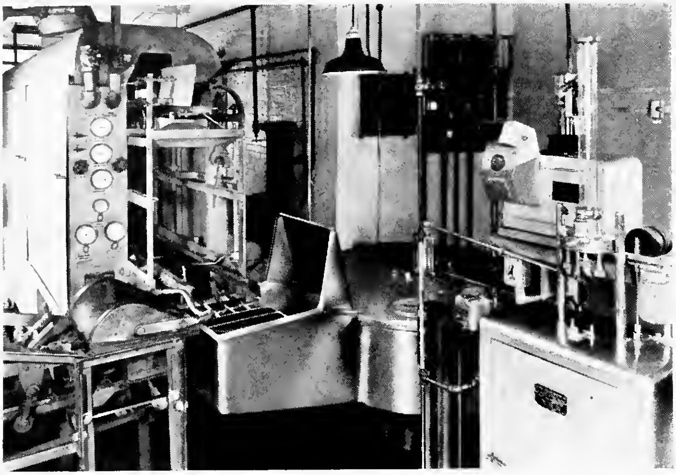
"It is a rather funny little story about how I got started in the Food Technology game. I was graduated from a Washington D.C. high school at the age of 17 and had taken a job as a messenger boy in the Department of Agriculture for the summer, planning on going to George Washington University at night and working on this government job in the daytime. This would have worked out very well because the job required only an hour or two a day and the rest of the time I could have studied.

"However, my high school chemistry teacher sent for me and told me about a job in a newly organized consulting laboratory in Washington which was incorporated under the name of 'The Institute of Industrial Research, Inc.' I realize now that the name sounds rather presumptuous, but at the time, 1910, there was not any other such laboratory. Arthur D. Little was just getting going and the Mellon Institute was in the talking stage.

"I started to work in this laboratory at the age of 17, but did not get the job I originally applied for because it took my teacher a month to locate me and by that time the job in the Road Materials Laboratory was filled. A new vacancy, however, had developed for a laboratory assistant in the Food and Drug laboratory which was under the direction of Dr. C. A. Crampton, one of Dr. Wiley's chemistry associates and later of the Bureau of Internal Revenue.

"After working in this laboratory for about six months, I remember doing a little intensive thinking and deciding that all the books on the subject of food chemistry seemed to be written from the standpoint of an analytical chemist who was trying to detect adulteration. I decided there must be a future for a young man who decided to use chemistry and engineering as tools for constructively improving food products and processes. This was in 1912 and that is the time apparently that I set out to become a food technologist—in fact, if not in name."

Mr. Rector stayed on in this laboratory for five years and then took an industrial job. This was interrupted by World War I. After the war he eventually returned to the Institute of Industrial Research for the purpose of becoming a partner to form a Division of Food Technology. This is attested in the minutes of a meeting of the board of trustees of that organization, duly signed by President Cushman and witnessed by Secretary Butler. Under the date of November



The automatic conveyors, scales, sampler, and can washer found in the receiving departments of modern dairies illustrate the principles of sanitary and efficient handling of raw materials adopted through the leadership of trained food technologists.

29, 1919, the following statements appear:

> *"The first business considered was a proposition presented by Mr. Rector. He offered to join the staff of the Institute as head of a new division which he suggested might be called the Division of Food Technology, and he felt confident he could secure a large amount of business . . . After full discussion of Mr. Rector's proposal, his offer was unanimously accepted, and he promised to begin his work at the Institute . . . on Dec, 1, 1919."*

Thus it was in Tom Rector's concept that the food technologist would utilize chemistry and engineering as well as Dr. Prescott's observations that "from . . . . . . our extended work in the bacteriological aspects of food preservation there has grown . . . a continuously broadening and healthy interest leading to numerous courses of instruction and to research in what we call Food Technology but which might perhaps with equal correctness be named Food Engineering" that the present-day profession of food technology had its roots.

The First Food Technology Conference was held 15 years after Dr. Prescott first offered a course in food technology. The conference brought together about 500 persons from Europe and America and resulted in a second conference at MIT in 1939.

The Second Food Technology Conference, in turn, led to the formation of the Institute of Food Technologists who held their first annual meeting in Chicago from June 17 to June 19, 1940. So marked was the need for such an organization that, in spite of war clouds and industrial turmoil, it grew to a membership of more than 800 food technologists during the year prior to the first annual meeting and has since grown to include more than 2,800 members.

Food Technology Defined

In creating the Institute of Food Technologists, the following definition of Food Technology was evolved and now constitutes Article II of the constitution of that professional society:

> *"Food Technology is the technological application of science and engineering to the manufacture and handling of foods. Food Technology is primarily based on the fundamentals of chemistry, physics, biology and microbiology, any of which sciences may find expression through an engineering operation. Knowledge of Food Technology enables its possessor to develop new products, processes, and equipment, to select proper raw materials, to under-*

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An Illinois Tech cooperative student samples smoked ham in the meat laboratory of Wilson and Company.

The Engineer and the Weatherman

by JOANNE STARR MALKUS*

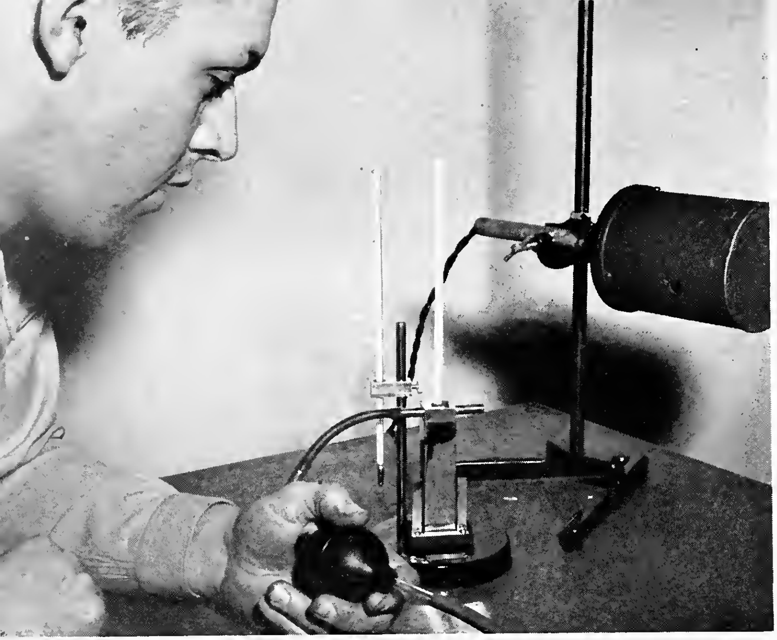
THE DAY of the "weather engineer" has not yet arrived. Not today nor even tomorrow will a trip to the Weather Bureau reveal a complicated set of lighted maps with levers labelled "fair and warmer", "light rain", etc. In contrast to the profession of engineer, which is one of doing, building, designing, stands that of the meteorologist whose main function is to predict.

That this prediction is often far from perfect is evident by the large number of jokes, cartoons, and radio programs of which the now somewhat defensive weatherman is the butt. Still, this motley humor reveals something more than the imperfections of our well-meaning civil servants in the weather station. It reveals the fact that the celebrated man in the street, despite his acquaintance with nuclear fission and relativity, is still unaware of how the weather really works. And this is no disgrace, since for sheer complexity atmospheric problems are at least as difficult of solution as those of the atomic nucleus of the stellar universe.

And yet, the atmosphere is the medium in which man carries on his daily life. It is as much his element as the sea is that of fish. Adverse weather may mean only a ruined vacation to the city-dweller, but it may spell flood or dustbowl to the farmer, and life or death to the air passenger. The famous Armistice Day storm of 1940 brought broken signs and show-windows to Chicagoans, but outside the city, 150,000 turkeys, thousands of cattle and livestock, three large lake steamers, and 157 human lives were lost.

Just as the atmosphere is the medium in which man lives, it is the medium

*Instructor of physics and meteorology at Illinois Institute of Technology.



The student learns to use the dewpoint indicator. This is one of the best ways to determine atmospheric humidity.

in which the engineer works, and with whose behavior symptoms, the weather, he must continually contend. A man building a dam must know how much water the structure will be called upon to handle, a fact that is determined to a large extent by the rainfall characteristics of the watershed. The pattern in the central Mississippi Valley, where the greatest rain is felt in May, is quite different from that of New England where each month sees almost the same amount of precipitation, although the total yearly rainfalls of the two regions are nearly equal.

A man designing an airplane must know what stresses may act on its wings. He must realize that the greatest structural damage to aircraft occurs in thunderstorms, where, due to updrafts and downdrafts side-by-side, relative vertical velocities often exceed 100 miles per hour, and where ascending currents can support hailstones the size of eggs. He must also be aware that these same conditions give rise to severe icing, and that the presence of liquid water cooled below its freezing point is vital in the growth of the great cloud-factory, cumulonimbus.

An engineer envisioning the growth of a great air terminal with day and night passenger service to far-flung points must know well the wind and weather characteristics of the site. He must know how to avoid the lee-side of smoke-stacks, the fog-covered valley bottom, and ocean promontory. He must be aware of the wind structure in the first 50 feet above the ground, because all take-offs and landings are made in that region. Indeed, the opportunities for the use of weather knowledge in engineering are far more extensive than can be indicated here.

So, while it is true that the engineer cannot as yet, design and build his own weather (perhaps it is just as well, since it is hard to foresee general agreement on this topic), he can make use to a far higher extent than the layman of what is already known about weather processes, and he can do this in two ways.

First, he can gain an understanding of the basic physics of the atmosphere; with his technical training and background in physics and mathematics, he is in an enviable position to do so. Second, he can learn to make use of existing weather services; he can learn enough of the language of the weatherman to call upon the vast stores of knowledge and information accumulated by the United States Weather Bureau and the university meteorology departments.

This has been the twofold purpose of those of us in the physics department at Illinois Institute of Technology who have had the privilege of organizing a course in meteorology, primarily for some of the junior and senior engineering students. We have not attempted to make forecasters of these students. They have not been required to spend long hours plotting winds and drawing isobars on multi-colored weather charts. Neither has it been our goal to make research meteorologists out of them, nor to enable them to fill blackboards with the differential equations of theoretical meteorology. During the years in which this course has been developing, the amount of mathematics has indeed been cut down and the emphasis on the physical principles increased. The postgraduate engineer cannot be expected to recall what the thermal wind equation is, but he can and should remember that over North America west winds generally increase with height and this occurs because temperatures are higher towards the South.

It is at this point, with the basic circulation principle, that the course begins. The students learn that, in addition to producing sunrise and sunset, the rotation of our terrestrial globe is a decisive force in cyclone, west wind, and the variability of Chicago weather. In fact, if the earth were standing still, northerly winds would prevail everywhere at the ground except at the shores of seas, for then the atmosphere would be circulating as does air in a room with a radiator at one corner, or like a convection cell with its heat source at the equator. From this simple convection cell, it is a long step to the motions of the real atmosphere flowing turbulently over a rough, rotating, continent-bespotted globe. Indeed, these complexities are so vast that their unravelling is still in its beginning stages.

Although the art of forecasting goes *(Please turn to page 30)*

HERMANN HESSE:

Nobel Prize Novelist

by F. K. RICHTER

WHEN in the Spring of 1946 I went by train from Chicago to New York, I observed a rather large group of men in the lounge car, singing, shouting, drinking. It was easy to see that they all had something in common, and most of them spoke English with a Scandinavian accent. Very soon I learned that they were Swedish-born Americans who lived in the northwestern states and were taking advantage of their first chance to go home to Sweden for a visit. Passenger liners had just started crossing the ocean again, and these men were anxious to be among the first across.

Beside me sat a more quiet man who belonged to the group and yet did not participate in the loud fun. He was reading. Two books were at his side, and he seemed to dream about something while watching the smoke of his cigarette. The larger book was printed in Swedish or Norwegian (I can't distinguish between the two): it was Knut Hamsum's *Hunger*. The second one was a very small volume in German.

"You have a rare combination of literature beside you," I said. "Why did you pick those two books for your trip abroad?"

My neighbor answered that he had not been home for more than 30 years, and that all during this time he had been dreaming about this very trip. He purposely had selected Hamsum's *Hunger* because it had meant so much to him during the last 30 years. Hamsum had helped him when he had become homesick, when he had wanted to pack and forget all about emigration. Hamsum dealt with such people in his book, he said, and he received strength and consolation from it.

The other book, the tiny one, was written by the German author Hermann Hesse, whom only a very few people in this country knew at that time. "You see," he said, "this book does not give me consolation; it gives me hope."

It was a story by Hesse about his return to the place of his childhood, after he had been away for a very long time. He returned hesitantly. Shortly before arriving there, he had a feeling of wanting to escape. But after he had seen the beloved place again, he discovered something that he had forgotten during all those many years of absence. Now that he saw it, the happiness of childhood returned to his heart. For the first time he felt happy again, and he was unable to explain how he possibly could have forgotten all that had meant happiness during his childhood years.

"You see," the traveller continued, "I hope that I find that old happiness again at home, in Sweden, and therefore, I am taking this second volume along because I have to read it over and over again until it becomes a part of my own life."

This conversation on a train suggests a kind of key to the understanding of Hermann Hesse's works. In most of his novels and other prose (there are almost fifty volumes of his prose work) he goes back to the years of childhood: he goes back to himself. The German poet Novalis is his favorite writer, and Novalis's question and answer—"Whereto are we going then?"; "Always toward home!"—swings like a leitmotiv through Hesse's world.

The motif, "Always toward home," has been interpreted in various ways during his 50 years of authorship. In one of his first books, *Knulp*, which still is one of his best known and beloved works, this "going home" means an actual return to the place of childhood, school, and first love. Knulp, the eternal tramp, with an innate wanderlust (he is the most charming, sympathetic, and touching vagabond ever portrayed), with no desire for labor, with his fine white hands and orderly clothes, wishes to go home when he feels that his tuberculosis soon will defeat him. On the way home, in a snowstorm, he dies listening to the Lord, who tells him: "In My name you have wandered, and ever and ever again aroused in the steady, industrious people a little longing for freedom. In My name you have committed follies and have been ridiculed; I Myself have been ridiculed and loved in you. You are My child and My brother and a part of Me, and you have enjoyed nothing, suffered nothing which I have not Myself shared with you."

In many authors' first works, the

(Please turn to page 50)

*Associate professor of foreign languages and literature at Illinois Institute of Technology.

SPORTS

AND

ILLINOIS TECH

by FREDERICK W. JAUCH*

(This is the first of two articles on the athletic program, past, present, and future, at Illinois Tech. The second article will appear in the December issue.)

AT Illinois Institute of Technology there is an unmistakable feeling of growth. Rarely does anyone express it in words of that sort, and perhaps most of the people who work and study at the Institute have never defined it to themselves in that way. But this certain subtle exhiliration is the spirit shaping Illinois Tech's numerous recent ventures. Usually it is enough to chat over coffee with a member of the faculty or administrative staff, or to idle through one of the serenely beautiful new campus buildings; even the casual visitor seems to catch it.

The Institute is now justifiably recognized as one of the very finest colleges of its kind. Its educational program offers courses and curricula not commonly found. Members of its faculty have become increasingly prominent in their fields. More and more, industry acknowledges its debt to Armour Research Foundation of Illinois Institute of Technology and to the Institute of Gas Technology. The Liberal Studies program and the various woman's curricula are no longer incidentals to the expansive, thorough Engineering division. And that vague dream of so few years ago —Technology Center of Tomorrow, where the most-serious, best-qualified young men and women live, work, and study on the most modern college campus in the world—will come to reality. Much of the planning and the campaigning and the labor remains to be done, but the people directing the development are not merely confident that the end will be achieved; they assume it.

If you have read somewhat on the expansion of Illinois Tech you will have noted that almost every phase of college life is being swept along with this development. But you may be one who wonders, "Where do athletics fit into this dream? Or have they been forgotten? Or have they been ignored?"

Will there be facilities, equipment, and staff for a good, effective recreational and athletic program? Will the varsity athletic teams be strong enough to make a reasonable showing against reasonable competition? Will the student body develop a spirit to support these athletic teams? Will Illinois Tech ever play inter-collegiate football? And in general, what is the attitude of the Illinois Tech administration toward athletics, both intramural and intercollegiate?

Physical Education and Intramurals

The present physical education program consists of lectures on hygiene and diet, corrective gymnastics, calisthenics, and sports. The intramural program includes basketball, boxing, golf, horseshoes, swimming, softball, tennis, touch football, and wrestling. Physical education instruction is handled by Grant M. Stenger; Edward W. Glancy directs intramural sports.

Although the present facilities are still far from adequate, they are much improved over those of several years

*Assistant director of public relations and director of athletic publicity at Illinois Institute of Technology.

ago. In the summer of 1947, one of five war-surplus buildings given to the Institute by the Federal Works Agency was made into a gymnasium. Two full-sized basketball floors were accommodated side by side, and rooms for wrestling, fencing, and boxing, offices for members of the physical education staff, and locker rooms were installed. However, the only swimming pool available was still that at the Valentine Boy's club, several blocks from the campus.

Ogden field was used for outdoor intramural sports and physical education classes. This arrangement was not ideal, especially in the spring when the intramural and physical education programs were forced to give up the late afternoon hours to the varsity track and baseball squads. Even so, the field was not large enough for both. The track team found itself high jumping and hurdling in short right field while the baseball team did its best to keep batted balls away from the vicinity. The baseball team discovered that the diamond and the outfield were far too rough, right field was much too small, and the windows of the new Chemistry building were too close to the left field foul line. All intercollegiate games were held on the Armour Square diamond, three blocks west.

A great deal of effort was expended over the summer in an attempt to improve this last situation; the outfield and infield turf was smoothened, a new track was laid, and new pole vault, high jump, and broad jumps pits were dug in more favorable places. The field this year will be reserved, for the most part, for the varsity squads. Fields for physical education classes and intramural sports are being created on areas north of Ogden field and west of the gymnasium.

These are the facilities for the year just begun. Undoubtedly it is the most feasible arrangement at the present time, and although it still leaves quite a bit to be desired, it will have to do until the better things come. And the Institute promises the students of Illinois Tech that the better things will come.

High on the priority list for construction, as part of the development program, are a gymnasium, a field house, a swimming pool, and a spacious athletic field. No construction date for either of the projects has been set as yet; nor can the administration predict that date. The difficulties are: (1) money must be raised; (2) the area must be cleared and new homes found for persons now residing there.

The gymnasium and swimming pool will be built at an estimated $642,000. They are to be constructed south of 32nd street and west of Dearborn street. The field house will cost approximately $925,000, and is to go up between State and Dearborn streets, between 31st and 32nd streets — roughly, just north of the present temporary gymnasium. According to present plans, the gymnasium and swimming pool are to be built before the field house. The athletic field will be

Carl Bergstrom (second from right), 1948-49 basketball captain, receives congratulations from Athletic Director John Schommer (second from left) upon award of an Illinois Tech letter and sweater. At extreme left is Bernard "Sonny" Weissman, assistant director of athletics; between Schommer and Bergstrom is Bill Smart, captain of the 1947-48 team; at extreme right is Ed Glancy, basketball and baseball coach.

Basketball action in the First Annual Illinois Tech Holiday Tournament for Chicago public high schools. This picture shows the eventual champions, Marshall High (white uniforms) turning back a strong Tuley team in one of the more heated contests of the meet. The tournament was held in the International Amphitheatre.

placed north of all three of these buildings, and the present Ogden field will then become a front lawn for the contemplated Library and Administration building.

With the physical development and expansion, there will also come expansion in physical educational courses, intramural sports, and the athletic staff.

"The physical education department is as important as any department in college, and must be so treated," John Schommer, director of athletics, has stated. "No other department in college teaches the love of good health and those character traits learned in athletic participation. But to do its job properly, the physical education department must have buildings, space, facilities, equipment, and coaches and instructors to provide a good worthwhile program for all."

The administration thinks so, too.

An Ignoble Concern at Illinois Tech?

And what about the intercollegiate athletic situation? Or is that a rather trivial and ignoble concern at Illinois Tech?

Is it trivial and ignoble? Some think so and would probably never be persuaded otherwise. But many of us think that it is not.

The desire to win on the athletic field, or to be represented by victory, is, of course, natural. Almost every one of us admits he loves it, and many of those who insist they do not probably have never been put to a good test. One would be surprised. This writer was, while attending the University of Illinois at the time of Illinois' famous Rose Bowl triumph over the University of California at Los Angeles on January 1, 1947. When the underdog Illini took the lead, then pulled away, and then turned the game into a glorious (for Illinois) rout, practically everyone hopped on the bandwagon, and, at least figuratively, walked down the snowy streets for days waving orange and blue pennants. No one seemed able to resist. That "practically everyone" included many of those instructors who usually found a rich satisfaction in flunking prospective all-American fullbacks. One very sophisticated professor who often ridiculed the nation's love for "so vulgar a sport" exuberantly exclaimed that he had celebrated with one Scotch and soda for each Illinois touchdown. And there had been a number of them.

An unexpected, overwhelming Rose Bowl victory is, of course, an extreme example, and in this case the memory of California insults and snubs for weeks before the game made the victory so much sweeter. But something in the nature of the human being is revealed by all of this. Many would say, no doubt, that because a thing is natural it is not necessarily, therefore, less ignoble. That, however, is an argument we shall leave, for the time being, to the Eighteenth Century Humanists and the Nineteenth Century Romantics.

Most people will agree that there is something much richer to be gained in spirited athletic competition than the pleasure of victory. We again quote John Schommer:

"The give and take of competition, the lessons of team play, the need to perform at one's best under pressure, the self-control required in obeying rules when emotions and tempers are up, the discipline needed to obtain the high physical ability to surpass in play, the desire to win, the sportsmanship, the rubbing of shoulders that urges each competitor to get along and be fair with his antagonist and yet play fiercely to defeat him—in these the person is taught the most valuable lessons in life."

To be of its greatest value, the game must be one that absorbs the performer. To get the most from the game he must give everything of himself to the game. That, of course, is as trite as it sounds, but like many trite things, it also happens to be true, not only in athletics but in all activities of man. Without the wholehearted striving for victory, a game of football, basketball, baseball, or anything else becomes little more than an hour or two of physical exercise. Physical exercise is a good thing in itself, in most cases, but its benefits are actually only a small part of those of sports.

The late Lou Gehrig said once, "I love to win; but I love to lose almost as much. I love the thrill of victory, and I also love the challenge of defeat."

Philosophically, then, the apparent end — the winning and the losing — is merely the means; but without that desire to win, the end is never realized. John Schommer has very well summarized these goals; I think there is one other value, perhaps not of as

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(The following article is the speech delivered by Dr. Newton before the Illinois Conference on Industrial Research at Armour Research Foundation of Illinois Institute of Technology May 27, 1948.)

Research Facilities in Illinois

by ROY C. NEWTON*

MAN HIMSELF has changed but little in the past 5,000 to 10,000 years. His intellect, the physiological processes of his body, and his nutritional requirements are about the same. On the other hand, man's ways of living have changed. In some parts of the world the changes have been minor. In other parts, particularly in our own country, the transformation has been almost complete.

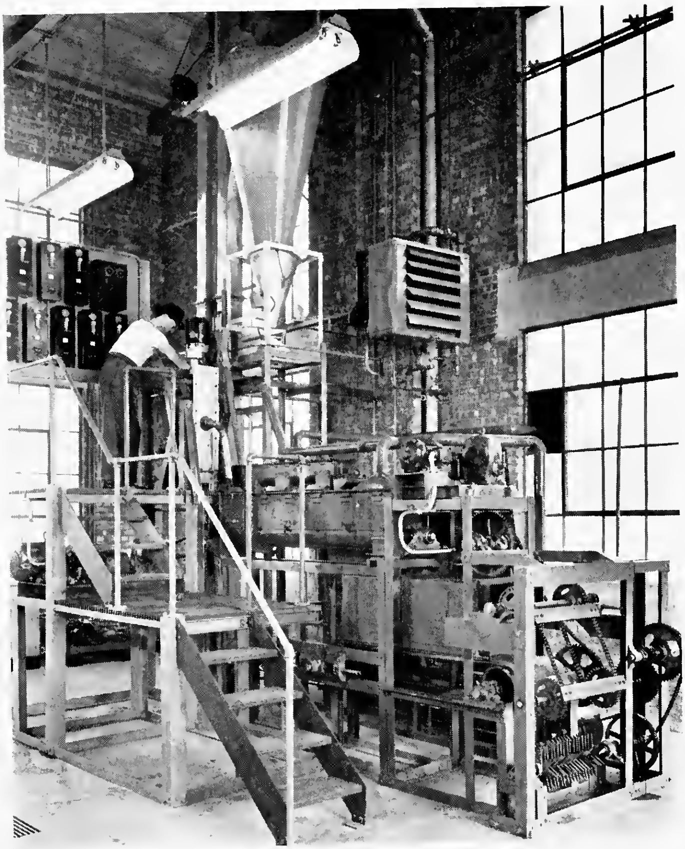
When we consider our own high standard of living, it is unbelievable that for more than half of the earth's two billion people, today's struggle for maintenance and shelter is just as bitter as it ever was. We don't need to read history books to get a picture of the condition from which we have progressed; we can still see it in many parts of the world today.

It is wise to ask ourselves how we have attained this high standard of living while others have failed to make material progress. How have we been able to progress from a condition in which 80 per cent of the people were required to extract from Mother Nature the food and clothing necessary for maintenance to the point where today 20 per cent of the people can supply these needs? How have we been able to extend the life expectancy for every infant born in America to more than two and one-half times what it was for our pre-scientific ancestors?

The answer is man's acquired ability to experiment and his use of inductive as well as deductive reasoning.

The ancient thinking man depended too largely on deductive reasoning. Some so-called wise men enunciated the general principles and all the rules were deduced from these unproven generalities. If the principles were wrong, then, of course, the rules were defective.

When man began to doubt any general law that did not check with his



Plant foods are mixed continually for study in this pilot plant in the plant food research laboratory of Swift and Company.

*Vice-president in charge of scientific research, Swift and Company, Chicago.

Dr. Newton (left) discusses the progress of an experiment in the Swift laboratories with E. J. Strandine.

own observations he was on the road of progress. When he took the next great step and learned to experiment, he was doing what we now know as scientific research. The laws of nature have always existed exactly as they are today and were always available for man to use as rapidly as he was able to observe and record their manifestations in a precise and orderly manner. Inductive reasoning was necessary in order to fit the various observations together to form a body of knowledge. Experiment was necessary to set up the condition which would force nature to reveal her secrets. The span of life isn't long enough to wait for the phenomena to occur naturally, so they can be observed, checked, and rechecked.

These two simple procedures, inductive reasoning and experiment, which seem so commonplace to us, make all the difference in our rate of progress as compared to that of our ancient ancestors. The time elapsed since these procedures were first used in a preliminary sort of way has been taken up in perfecting the techniques, inventing tools to make more precise observation, and teaching the method to more and more people.

The natural curiosity of man and the urge to improve his condition seem to have existed as inherent traits since the beginning. The development of the method of scientific research and its acceptance have been hampered and delayed by tradition and habits which formed the behavior patterns, and had to be discarded. Many of these still exist and only a small per cent of the people are able to hurdle these barriers. Thus human progress depends almost entirely on this small group who, because of inspiration and training, are able to cast off the prejudices and superstitions of their youth and accept only the reproducible experiment.

Man has attained his position by the use of his brain, and his highest mental attainment as well as his highest standard of living have come about through his acquired ability to experiment and through his use of inductive as well as deductive reasoning. It is highly fitting, therefore, that you as leaders in our industrial civilization should take part in this symposium on the use of the scientific method for the betterment of mankind.

Support for Research

I have been asked to discuss research facilities in Illinois.

There are many ways by which these facilities might be classified. After consideration it seemed most appropriate to use that classification which will reveal the trends of research as well as the kind and extent of Illinois facilities. Therefore, my approach is — what are the various sources of support for scientific research?

There are three primary sources: I think we should name first the *endowments to our universities.* It seems to me that this source of support has imposed fewer restrictions or directive influences than any other and has thus resulted in the greatest production of *exploratory* research.

The second might be the *federal and state support of universities and experiment stations.* While these institutions have done great work in the fundamental sciences as well as applied research, it should be clearly recognized that they are working for a client — the voting and taxpaying public which does and should exert an influence to favor research which will help to solve practical problems. This influence is subtle and indirect but, nonetheless, forceful and effective in directing the course of research toward applied ends at the cost of true exploration.

The federal government has supported research both directly and indirectly for some years and in very recent years has been the largest contributor. Of course, this is taxpayers' money and should be subject to the same review always needed when one group undertakes to spend money belonging to someone else. Since it is tax money, it must be placed in the same class as the state support of research. This will indicate the restriction which must surround the projects receiving this support. Since the money comes from a client (the taxpayer) there will always be pressure to make it serve a useful purpose for the client. You know from experience what happens when political pressure reaches for Uncle Sam's pocketbook. First it is

one group looking for a small privilege, and then a second, and then a third, and so on. One group has a commodity which has grown obsolete on a competitive market and it wants help from the scientists; another group wants part of the money spent in its geographical district whether there are any scientists there or not; another group is interested in the development of some natural resource; another wants a cure for some animal or plant disease which is cutting into its livelihood; and last but not least, other groups will have their popular fad with respect to some human disease or some social problem. Imagine the confusion arising from an attempt to satisfy all of these privilege seeking groups, each having its congressional champion who is willing and waiting to espouse the cause of his constituents.

The government was fortunate in the selection of some of its scientific leaders for war research. Though I have no doubt there was much waste of public funds due to inefficiency and poor direction, this we can readily excuse as a result of haste and war necessity. We can even laud the success attained under such stress.

The third source of support is *industry*. Now, it should be remembered that the objective of industrial research is to help earn a profit. The most fundamental aspect of our system of competitive enterprise — the thing that makes it work, the thing that has built our great industries, the thing that has helped to advance our standard of living, the thing that has made our nation great — is that if an industry serves the public it will succeed and if it does not serve the public it will fail and cease to exist. Industry knows that a measure of its success is also a measure of its public service. Industry is, therefore, quick to embrace any enterprise which will help it to perform a public service, for that is its only justification for a profit. The support of industrial research is another manifestation of this principle.

It thus becomes perfectly clear that research conducted by industry is pointed toward some application or the development of information which will be useful in application some time in the future.

Industry is making more and more research grants without restriction to universities. Such support from industry would appear to equal the endowments in the freedom it provides to the research worker. This would be true except that most of them are made for specific projects and if a scientist wishes to avail himself of these resources he must qualify for and be willing to undertake these particular projects. It may be true that the projects originated in the mind of the individual scientist, but the industry placing the grant probably had many applications from which to choose, and thus by exercising selection directed its support toward problems of its interest. The redeeming element in such a system comes from the fact that many different types of industry are now following such a plan thus affording wide opportunity of selection to the academic scientists as well. It should be pointed out that industry has recognized its dependence on fundamental research as a foundation for its future and as a result has liberalized its views considerably. There is every reason to believe that such liberalization will continue to provide the necessary support with increased freedom for exploratory research.

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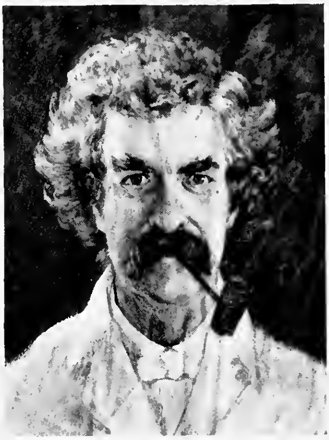
This Swift & Company laboratory at Hammond, Indiana, is devoted to research in plant food manufacture and insecticide-fungicide formulation.

Mark Twain's Adventures in Inventions

by EARL C. KUBICEK*

ON THE evening of November 30, 1835, the assembled village folk in the small Missouri town of Florida saw the electrifying spectacle of Halley's comet streaking across the darkened skies. It was on this night, in a tiny one-room house, that a feeble, premature child was born to the family of the village store-keeper, John Clemens, and his wife, Jane. The child was named Samuel after John Clemens' father, and Langhorne, in honor of an old Virginia friend. No one in the little inacessible hamlet on the banks of the Salt River could have predicted that the puny, seven months' infant would one day become the toast of kings and sages.



In a life which included many of the world's pleasures and a good measure of its sorrows, Samuel Langhorne Clemens was to give to the world the full fruits of his genius. He passed away on April 21, 1910, with the reappearance of Halley's comet, that mysterious messenger of his birth year. Clemens once remarked in conversation, "I came in with Halley's comet in 1835. It is coming again . . . and I expect to go out with it. It will be the greatest disappointment of my life if I don't go out with Halley's comet." His wish was granted.

It seems remarkable to reflect that Samuel Clemens, known now to the greatest part of the literate world as "Mark Twain," should have found time in an extraordinarily busy life to indulge himself in a host of the inventive schemes of others and inventions of his own creation. It is still a matter of much discussion whether some of them, under proper management, might not have turned out to his business advantage rather than becoming sinkholes for funds supplied by him.

Twain undoubtedly believed his own maxim, "name the greatest of all inventors: Accident." In the later years of his life he was able to write somewhat dispassionately, or at least as dispassionately as was possible for so mercurial a character as Mark Twain, about some of these schemes which he had taken at their face value and which later turned out to be veritable faces of Siva. He wrote, "An old and particular friend of mine unloaded a patent on me, price $15,000." This was a minor investment insofar as dollar prices go. However, in this particular case he added. "Then began the cash outgo of $500 a month." Even in the face of such thoughts he was able to interject humor. "That raven flew out of the Ark regularly every thirty days but never got back with anything, and the dove didn't report for duty." According to his own estimates, he lost $42,000 on this venture.

Another friend approached him with an invention: an engine or furnace that would get ninety-nine per cent of all the steam that was in a pound of coal. Twain was advised by experienced engineers against backing this proposition but he could not resist the lure of the claim, supporting the development of the device to the extent of about $5,000. He wrote, "It did save one per cent of the steam that was in a pound of coal, but that was nothing. You could do it with a teakettle."

Of a steam-pulley device Twain says, "It pulled $32,000 out of my pocket in sixteen months and then went to pieces."

Growing tired of backing the inventions of others, Mark Twain turned his hand to creating something himself. The result was a scrapbook which he claimed "was the only rational scrapbook the world has ever seen." This was at the time of the production of his play, *The Gilded Age*, and writing to his friend, Dr. John Brown, the author of *Rab and His Friends*, in Edinburgh, he said, "I have backed down from letting it be known as mine just at the present," (referring to the scrapbook). "I can't stand being under discussion on a play and a scrapbook at the same time." He turned the actual production of the scrapbook over to another and later commented, "By and by, just when I was about

*Executive secretary of the Alumni Association of Illinois Institute of Technology and director of alumni relations.

to begin to receive a share of the money myself, his firm failed." Twain wryly added, "I didn't know his firm was going to fail; he didn't say anything about it."

Looking back on the spring of 1877, Mark Twain was able to recall in his later years that he was approached at that time by an agent for one Graham Bell who sought to interest him in an invention called the telephone. The agent could not interest Twain, however. Twain wrote, "I declined. I said I didn't want anything to do with speculation." He did claim, however, to have had the first telephone line ever used in a private dwelling in his house in about 1878.

"What a wee little part of a person's life are his acts and his words." Perhaps Mark Twain believed this statement of his, but it is through his written word in his journals and letters that we can know the man with remarkable clarity. He never kept a consistent, orderly journal. He never could be typed as being that prosaic. He was, however, constantly making jottings and notes on the spot, capturing the true spirit of the idea or event. His notebooks were his own idea—generally with a limp morocco leather cover and in pocket-size with projecting ears on each page, so that as the page was used he could tear off the ear and thus always find his place very quickly.

In the pages of these notebooks we find a comment that is prophetic of the television of our present day in the line, "Portraits and pictures transferred by light accompanying everything."

He believed in experimentation and practiced it in some measure. He owned one of the first typewriters to be marketed but claimed that the writing machine was his master, not he the master of the machine. He pleaded with the manufacturer of the typewriter not to advertise the fact that he, Twain, owned one of their machines, for he said that he received so many requests concerning its operation after sending a typewritten letter that it was more of a time-consumer than it was worth.

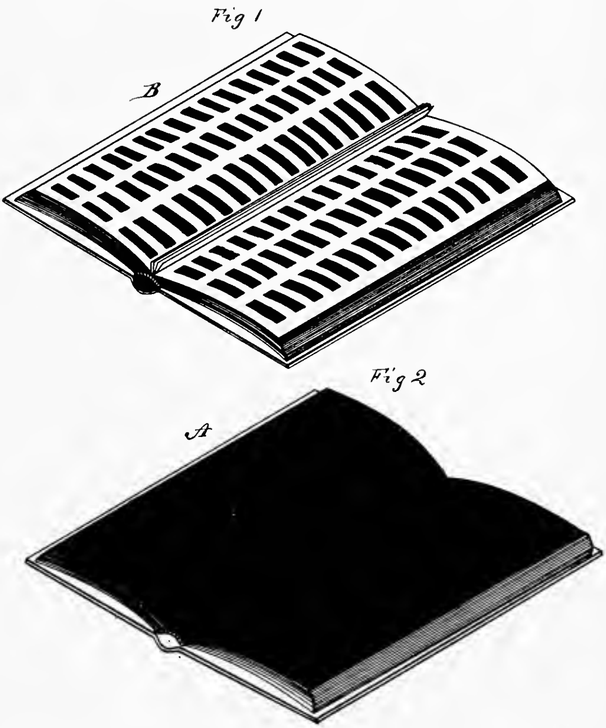
The Kaolotype, a new method for marine telegraphy, the Paige typesetter, a history game, a clamp for children's beds, a carpet-designing machine—all these followed each other or competed for Twain's interest through the years.

The Kaolotype, an ingenious chalk-plate device for engraving illustrations, would, Twain felt, ". . . utterly annihilate and sweep out of existence one of the minor industries of civilization." He was so enthusiastic he bought four-fifths of the patent rights from his old friend of "Quaker City" days, Dan Slote, for "several thousand dollars." There were many ways in which the Kaolotype could be used, Twain felt. In his estimation its success was a sure thing, and he wrote to his brother, Orion, "No rights will be sold for a year, yet." His idea was to apply the process to mouldings of bookbinder's brass stamps in place of engravings. He went so far along with

S. L. CLEMENS.

Scrap-Books.

No. 140,245. Patented June 24, 1873.



Witnesses:
Franck L. Ourand
C. L. Evert.

Inventor.
Samuel L. Clemens
per [illegible]
Attorneys.

121,992

UNITED STATES PATENT OFFICE.

SAMUEL L. CLEMENS, OF HARTFORD, CONNECTICUT.

IMPROVEMENT IN ADJUSTABLE AND DETACHABLE STRAPS FOR GARMENTS.

Specification forming part of Letters Patent No. 121,992, dated December 19, 1871.

To all whom it may concern.

Be it known that I, SAMUEL L. CLEMENS, of Hartford, in the county of Hartford and in the State of Connecticut, have invented certain new and useful Improvements in Adjustable and Detachable Elastic Straps for Garments; and do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawing, and to the letters of reference marked thereon making a part of this specification.

The nature of my invention consists in an adjustable and detachable elastic strap for vests, pantaloons, or other garments requiring straps, as will be hereinafter more fully set forth.

In order to enable others skilled in the art to which my invention appertains to make and use the same, I will now proceed to describe its construction and operation, referring to the annexed drawing, in which—

Figure 1 represents an elastic strap made in two parts, C C′, each part being provided at one end with one or more button-holes, *c*, and the other ends of said parts connected by a buckle, *c*′. Fig. 2 represents an elastic strap made in two parts, D D′, each part being provided at one end with one or more button-holes, *d*. The part D has at the other end several rows of holes, d^1 d^1, into which hooks d^2 at the other end of the part D′ are to be inserted. This end of the part D′ may be lengthened or shortened by means of a slide, d^3, as shown.

It is obvious that my adjustable straps may be made non-elastic as well as elastic without departing from my invention; but I prefer to make them elastic.

The vest, pantaloons, or other garment upon which my strap is to be used should be provided with buttons or other fastenings on which the strap is to be detachable and adjusted. When changing garments the strap may readily be detached from one and put on another.

The advantages of such an adjustable and detachable elastic strap are so obvious that they need no explanation.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

As an article of manufacture, the adjustable and detachable back-strap for garments, it being provided with devices for adjusting its length, and with button-holed ends for direct attachment to the clothing, substantially as set forth.

In testimony that I claim the foregoing I have hereunto set my hand this 9th day of September, 1871.

SAML. L. CLEMENS.

Witnesses:
C. L. EVERT,
A. N. MARR.

(38)

his plans that in 1881 he was writing to his sister, "Now I am also putting up a building in New York for my brass-casting works." Yet this beautiful dream, seemingly so practical at the time when he first purchased controlling patent rights in February, 1880, deteriorated until finally in May, 1881, he wrote to the manager of his printing house, "For our lawyer's information I will state . . . I propose to arrest Sneider (the young machinist Twain had retained to develop the idea) on the charge of obtaining money under false pretenses." Thus the Kaolotype joined the realm of broken dreams.

The Paige Typesetter, which began to interest Twain about 1881, proved to be one of the major tragedies of his life. It seemed to have an almost insatiable appetite for monetary resources. Before he was through with it, Twain had invested more than $300,000 in the machine. The Paige machine was described as "one of the most wonderful typesetting machines ever invented." The patent application, with 204 pages of drawings, was first filed in 1887. The machine had 18,000 separate parts, with the operator bringing down whole words at a time, the machine doing the justifying by means of eleven different sizes of spaces.

The story of the Paige episode runs through many pages of Twains's letters and notes, with the varying degrees of his optimism and pessimism apparent as the device performed or failed to perform its various tests. According to one source, in the initial stages of the development of the Paige machine, the promoters of the Mergenthaler machine offered to exchange a portion of the interest in their typesetter for an equal interest in the Paige machine, thus to obtain a wider insurance of success. In Twain's mind the offer only confirmed his trust in the ultimate perfection of the Paige typesetter, and he refused it. Due to an almost incredible intricacy of operation, Twain's typesetter never met with operational success. It could not be successfully maintained for practical operation. Its inventor, James Paige, like Mark Twain himself, was too much a perfectionist and insisted on constantly tinkering with his machine. As a result, the machine was never in a completed state, and Twain was finally forced to give up the vampiric creature.

Flitting among these depressing financial chapters like paragraphs on a page were other creations, figments of Twain's creative mind. His "History Game," invented originally for

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UNITED STATES PATENT OFFICE.

SAMUEL L. CLEMENS, OF HARTFORD, CONNECTICUT.

IMPROVEMENT IN SCRAP-BOOKS.

Specification forming part of Letters Patent No. **140,245**, dated June 24, 1873; application filed May 7, 1873.

To all whom it may concern:

Be it known that I, SAMUEL L. CLEMENS, of Hartford, in the county of Hartford and in the State of Connecticut, have invented certain new and useful Improvements in Scrap-Book; and do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, making a part of this specification.

The nature of my invention consists in a self-pasting scrap-book, as will be hereinafter more fully set forth.

In order to enable others skilled in the art to which my invention appertains to make and use the same, I will now proceed to describe its construction and operation, referring to the annexed drawing, which represents perspective views of two of my scrap-books.

A and B represent two scrap-books of any desired dimensions, and made, as far as material, binding, &c., is concerned, in any of the known and usual ways. The leaves of which the book A is composed are entirely covered, on one or both sides, with mucilage or other suitable adhesive substance, while the leaves of which the book B is composed have the mucilage or adhesive substance applied only at intervals, as represented in Fig. I.

In either case the scrap-book is, so to say, self-pasting, as it is only necessary to moisten so much of the leaf as will contain the piece to be pasted in, and place such pieces thereon, when it will stick to the leaf.

I do not wish to be understood as claiming a book-cover having short guards coated with an adhesive substance, as I am aware that such is not new.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

As an article of manufacture, a scrap-book, the surfaces of the leaves whereof are coated with a suitable adhesive substance covering the whole or parts of the entire surface, all as set forth.

In testimony that I claim the foregoing I have hereunto set my hand this 15th day of April, 1873.

SAML. L. CLEMENS.

Witnesses:
A. N. MARR,
ESAU HALL.

Food Technology Comes Into Its Own . . .

(Continued from page 8)

stand and control food manufacturing operations, to solve technical problems of food manufacture and distribution, including those involved in plant sanitation and those affecting the nutritional value of public health safety of foods, and to know the fundamental changes of composition and of phsyical condition of foodstuffs which may occur during and subsequent to the industrial processing of the foodstuffs."

It is readily appreciated by one who reads—and digests—such a definition that the profession of food technology is indeed a broad one. Nevertheless, its broadness — and, incidentally, its opportunities—are understandable to anyone who critically reviews the three major developments within food industries since the turn of the Twentieth Century. Today, the greater portion of our food no longer goes directly from the agricultural producing centers to the consumer; it passes in ever increasing quantities through food processing establishments that prepare and distribute it to our citizens and to the rest of the world. That was the first major development.

The second major development began with the discoveries early in the Twentieth Century that nutrition could and did suffer when the emphasis in food processing was directed at mere preservation. Bacteriological and chemical tests were supplemented by animal feeding experiments for the purpose of determining what losses of precious vitamins and minerals occurred in processing. New findings in research laboratories began to result, with astounding rapidity and success, in new manufacturing techniques in the plant.

Quite aside from the primary purpose of making a profit, progressive management in food industries now appreciates its responsibility to give the public food that is not only safe but also possessed of maximum nutritional value.

However, important as these two developments have proven to food industries, it is the third significant change that is of most interest to those interested in careers as food technologists. As a matter of fact, food technologists are the result of this recent change, for the time when a baker was just a baker is rapidly passing into the limbo of antiquity. The tremendous technological advance being made today in food processing is one of horizontal operations. Recognition that the same basic unit operations are used by food processors, irrespective of the raw materials with which they start, or the finished goods with which they end, has made diversification possible. Such diversification portends a more profitable industry in good times, and a more depression-proof one in periods of economic stress.

Yet, in all of these changes the food technologist has been heavily involved. As Past-President Harvey of the Institute of Food Technologists has so aptly stated: "The properly equipped member of our profession is indeed a versatile person. He not only must be certain a food is bacteriologically safe, but that all essential nutrients are conserved, undesirable oxidative and enzymatic changes minimized, flavor and eye appeal retained, packaging good, and label claims consistent with fact — all within sound engineering practice, and at a cost the consumer will pay."

Swiss cheese wheels curing in a Wisconsin factory.

These responsibilities cannot be lightly regarded any more than the incidental tasks can be disregarded. The theories first propounded by Benjamin Franklin, and later developed more fully by Malthus 150 years ago and by Crookes nearly a century later, concerning the relation between food supply and necessary limitations of population are still plaguing thinking men. While it is true that such theories can be upset by new discoveries to the extent of rendering their serious concern among the foolish occupations of men, we are still confronted with the fact that approximately 11 per cent of the land areas of the world, a total of four billions of acres, will produce food. The fertility of this land depends upon six or seven inches of top soil. Our global population is approximately 2,000,000,000. This simply means that the topsoil overlying two acres of land is the margin that separates each one of us from starvation. With the world's population increasing, with concomitant erosion, neglect, and reckless exploitation, and with the threat of future terrible wars, our margin of safety is growing smaller. Eventually, therefore, the food technologist must not only become concerned with and interested in the broader aspects of food production but in the application of the scientific method to our social problems as well. Never was the need greater and more insistent than it is today for well-trained food technologists—and particularly those with an appreciation of human relations.

The I.I.T. Food Technology Council

In developing the curriculum for its undergraduate course in food technology, Illinois Tech has given due consideration to the humanistic trends and apparent industrial requirements being sought in those individuals planning careers as food technologists. In order to make certain that its interpretations are correct, a Food Tech-

(Please turn to page 24)

Kodak

(Continued from page 22)

nology council, consisting of leaders in the food industries, has been appointed by President Heald. These men will counsel the staff in policy matters pertaining to curriculum, scholarships, fellowships, research projects, and job placements; they will help Illinois Tech train food technologists fully capable of meeting the qualitative demands that industry is most apt to apply. The men serving Illinois Institute of Technology through membership on the Food Technology council are:

F. C. Buzzelle, products control executive, General Mills, Inc.; Berton S. Clark, director of research, American Can company; George A. Crapple, director of research, Wilson & Company, Inc.; Victor Conquest, director of research & development, Armour & Company; Albert L. Elder, director of research, Corn Products Refining company.

George Garnatz, director, the Kroger Food Foundation; Philip P. Gott, president, National Confectioners' Association; Charles E. Gross, director of scientific research, John Morrell & Company; Lloyd A. Hall, technical director, the Griffith Laboratories; Lee Hickox, vice president, Container Laboratories, Inc.; Rohland A. Isker, secretary, Associates Food and Container Institute.

William G. Karnes, vice president, Beatrice Foods company; Norman H. Kraft, vice president, Kraft Foods company; Henry R. Kraybill, director of research & education, American Meat Institute Foundation; Francis H. Kullman, Jr., vice president, Bowman Dairy company; Allen L. Malone, general manager of research, Continental Can company.

Paul D. V. Manning, vice president, International Minerals & Chemical corporation; Harold M. Mayer, vice president, Oscar Mayer & Company; R. C. Newton, vice president, Swift & Company; F. N. Peters, vice president, The Quaker Oats company; Thomas M. Rector, vice president, General Foods corporation.

H. N. Riley, vice president, H. J. Heinz company; J. G. Shakman, executive vice president, Pabst Brewing company; Fred P. Siebel, Jr., president, J. E. Siebel Sons' company, Inc.; E. S. Stateler, associate editor, Food Industries; Robert I. Tenney, president, Wahl-Henius Institute.

Food Technology at Illinois Tech

It is well recognized that food industries were seeking and accepting food bacteriologists and food chemists as technically trained personnel 25 to 30 years ago when formal training in food technology was not available. Many of these graduates upon entering industry found that their training had not been fully adequate; the need for some engineering background soon

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DU PONT *Digest*

For Students of Science and Engineering

From tire cords to football pants

Do you know about nylon's other lives?

Here's a surprise for those who think of nylon mainly in terms of stockings and lingerie.

Nowadays, nylon fibers — twice as strong and half as heavy as the same size aluminum wire—are doing a variety of jobs, better than any previously known fiber. Off Labrador, men are harpooning whales with nylon lines. In a New England textile mill, abrasion-resistant nylon ropes now drive big "mule spinners" for periods ten times as long as other commercial materials, without a breakdown. Nylon fabrics are being used in everything from rugged automobile seat covers to delicately woven filter cloths.

In its plastic form, nylon is used to make everything from unbreakable dishes to hypodermic needles. As a monofilament, it goes into a variety of products from brush bristles to surgical sutures.

Nylon owes its origin to a Du Pont fundamental research project begun in 1928. A group of scientists set out to find out how and why the molecules of certain substances polymerized to form giant chainlike molecules. Hope of obtaining a new commercial fiber was first aroused when, two years later, a polymer was developed which could be drawn out into a thin strand, like taffy candy. The complex problems which followed called for the services of over 200 Du Pont men and women, among whom were some of America's most competent scientists and engineers.

Research—a Major Du Pont Activity

Nylon is an excellent example of modern research at work at Du Pont. Young scientists joining the organization now may share in other discoveries of outstanding importance. They may find opportunities in such challenging fields as finishes, coated fabrics and various fibers; synthetic organic chemicals, including fine chemicals; synthetic rubber; electro and agricultural chemicals; plastics; pigments and photographic film; and high pressure synthesis.

Each of ten manufacturing departments of Du Pont has its own staff and is operated much like a separate company. Within each, research men work in groups small enough to bring quick recognition of individual talent and capabilities.

Year after year, young, inquiring minds come from leading U.S. schools of science and engineering to Du Pont —where individual ambition is matched with opportunity, cooperation and the type of friendly support that brings out the best in each person.

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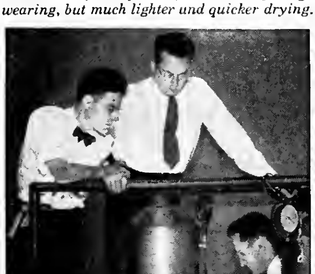
Nylon football uniforms, *as worn by Bobby Jack Stuart, Army back, are not only tough wearing, but much lighter and quicker drying.*



Nylon research: *O. C. Wetmore, Ph. D. Phys: Ch., New York U. '44; D. A. Smith, B. S. Mech. Eng., Purdue '40; C. O. King, Sc. D.-Ch. E., Mich. '43, charging experimental condensation polymers to a spinning machine.*

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(Continued from page 24)
became apparent to them as well as to their employers. Therefore, in more recent years, food industries have been prone to seek chemical engineers. However, these graduates have been at a disadvantage because of a lack of training in the biological sciences of fundamental importance in food processing techniques and production developments. To cope adequately with the situation, the course in food technology at Illinois Tech will have a major sequence in chemical engineering, supported by basic training in the sciences of biology, chemistry and physics. Production development and management options will be offered for individuals so inclined. Both graduate and undergraduate courses of study will be developed.

Ideally located in the Food Capitol of the World, with the multitude of food industries located in Chicago's industrial area, Illinois Institute of Technology has developed a cooperative plan with selected food processing organizations whereby the student can alternate periods of study and work. Under such a plan, it is contemplated that the student will be able to earn sufficient money with which to finance his education and will also receive invaluable practical experience that will enable him to better understand and appreciate his academic studies and laboratory assignments. The arrangement has the practical value, not only of making for better students who must work diligently, but, in addition, preparing students who may enter industry upon their graduation not having to serve a probationary period before they fully adjust themselves to industrial requirements.

No greater problem confronts industry today—including food industries—than that of human relations. A food technologist who in his training period learns how to "get along" with his fellow workers will find such experience invaluable. That this last advantage and the others just enumerated are readily recognized and appreciated by food industries themselves would appear to be confirmed by the ready support Illinois Institute of Technology is receiving in presenting its cooperative plan of training to food processing companies in the Chicago area. Among those companies who are actively developing such programs for their employees as well as for Illinois Tech students are: Wilson & Company, Continental Can Company, Armour & Company, Kraft Foods Company, Oscar Mayer & Company, Red Star Yeast and Products Company, Libby, McNeill & Libby, E. J. Brach and Sons, and Bowman Dairy Company. Illinois Tech is fully cognizant of the opportunity and the challenge that such "partnerships in food technology" provide.

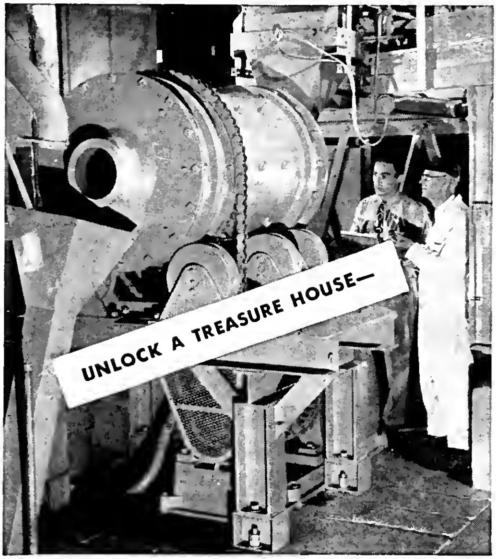
Future Prospects

We opened this discussion with the statement that "food technology as a profession, is just beginning to come into its own." Such a conviction will find ample confirmation in a few salient facts.

Food is America's biggest business —a \$44,000,000,000 business at retail, according to leading investment counselors. Our farmers have the highest cash market in the world. We process, export and eat more food than any

other nation. In war or peace, good times or bad, food always heads the list. Processing and distributing is the business responsibility of the American food industry. Today that industry is on the threshold of another revolution or development. The war has radically changed the eating habits of large numbers of people, while the armed forces and industry together have pioneered new developments in both processing and nutrition. Food, incidentally, is the largest single item in the American budget; the average family spends nearly one third of its annual income in providing a full larder. To process and distribute the vast bulk of its goods, the food industry utilizes the services of well over a million people and has an annual payroll exceeding \$1,700,000,000. This includes only the people employed in milling the wheat, smoking the hams, freezing the peas and the other similar operations — to build machinery, run the transport, and staff the retail stores, another 3,500,000 Americans earn over \$10 billion a year. Then, too, the greatest expansion and most rapid corporate growth in the history of food industries has taken place during the past 25 years.

Though there are many uncertainties facing the American food industry in the future, managements are generally optimistic. Individually, food processors are concerned more directly with their competitive struggles with each other. As time marches on, quality, price and convenience—stimulated by advertising and consumer education—will resume its old im-
(Please turn to page 28)


UNLOCK A TREASURE HOUSE—


UNLEASH A THUNDERBOLT—


LISTEN TO THE SUN—

(Continued from page 26)
portance to the housewife. Women have learned to appreciate—and demand—prepared foods that still taste like home cooked foods. These foods must be reasonably priced and conveniently packaged. Proper preparation for the table still remains to be more fully developed. It is clear, however, that housewives do not intend to go back to their former hours of kitchen drudgery.

In planning to cope with this growing revolution and development, food industries continue to spend huge sums on modernization and expansion. Research, including both the basic scientific and the experimental kitchen varieties, is coming in for large budgets. Pilot plants and test marketing operations are being organized and conducted most scientifically. And consumer education is growing on a fully professional basis.

The role which the food technologists will be asked to play in this continuing growth and expansion of food industries is one in which all the resources of the sciences of biology, chemistry and physics, as expressed through engineering operations," will be brought into play. We will begin to hear, for example, more about engineering principles applied to nutritional as well as sanitary problems. Some of the mileposts to watch are perhaps suggested in just one small segment of food industries — namely, baby foods. In the past ten years, a 3,000 per cent expansion has taken place; this promises to put the business in the $120,000,000-a-year bracket in 1948. The original talking point in favor of these products was convenience; today the chief emphasis is being placed on the nutritional values of such foods, scientifically prepared to conserve their vitamins, to insure their purity, and to provide their uniformity. A recent survey has shown that 84 percent of American families use some kind of prepared baby foods and, curiously enough, among families with no children under three years of age, 16 percent are buying such products anyway. Just a straw in the wind perhaps—but a straw worth watching.

Of one thing, we can be certain. The managers of American food industries —distracted as they are by a myriad of current problems—still have their sights clearly set on the future. That future is expected to bring to the average American table a variety and abundance scarcely dreamed of a short 25 years ago. And in charting its course to such futures, management is going to find it necessary to rely increasingly upon young men trained in a knowledge of foods with emphasis upon the scientific and technological aspects of food manufacturing, handling and distribution from the biological, physical, chemical and engineering standpoints. In other words, *the food industries' leaders of tomorrow will be recruited from among the ranks of today's food technologists!*

Production of Marine Hardware at ELCHINGER FOUNDRY, NEW ORLEANS, Demonstrates Efficiency of GAS

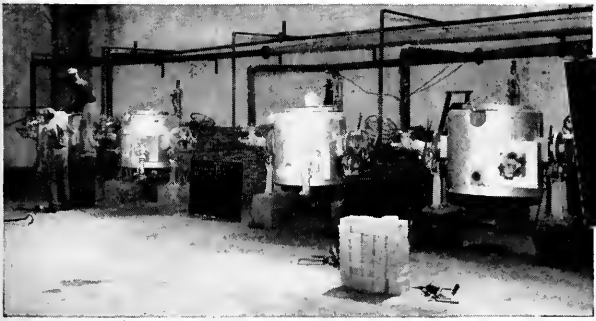
TEMPERATURE CONTROL is one of the most important factors in melting brass and bronze. And the strict control of each heat is especially important in the production of marine hardware which is subjected to extreme service conditions.

At the Charles F. Elchinger foundry in New Orleans, metallurgical supervision is facilitated by the use of four Gas-fired crucible furnaces which are so precisely regulated that any desired temperature can be maintained. This accurate control is necessary because various alloys require temperatures varying from 1850° F. to 2300° F.

But controllability is just one of the features which makes GAS the most desirable fuel for non-ferrous foundries. The four Gas-fired furnaces in the Elchinger foundry can be brought to heat in 2½ hours from a cold start or 1½ hours in succeeding heats—a simple demonstration of the speed of GAS.

The flexibility of GAS is important, whether it is used in a small foundry specializing in certain alloys, or in a large plant melting many types of non-ferrous metals. That flexibility is emphasized in the production control made possible in the Elchinger foundry by the use of four small furnaces capable of economical heating and reheating, at high speed, with GAS. In addition, cores are baked in Gas-fired ovens.

In every non-ferrous foundry operation requiring heat—for core-baking, melting, ladle heating—there's a job for GAS and modern Gas Equipment worth investigating.



Employees prepare one of the four crucible furnaces for charging. These Gas-fired tilting furnaces are rated at 600 pounds each.

AMERICAN GAS ASSOCIATION

420 LEXINGTON AVENUE NEW YORK 17, N. Y.

The Engineer and the Weatherman

(Continued from page 10)

back to the omens of the ancients and the sailors' yarns of "rain before seven . . . . . .", the science of meterology is young. Therefore, it does not seem worthwhile to crowd the mind of the engineer with the details of new, conflicting, and still tentative theories. But even though they cannot yet be fully explained, the large-scale features of atmospheric circulation can be described in ever-increasing detail. And this description need not be a dry dissertation on high- and low-pressure areas, clockwise and counter-clockwise winds, and the annual rainfall at Pongo-Pongo, but can be vividly connected with our own day-to-day experience.

Every Chicagoan, for example, has his own reaction, however bitter, to the climate of his native metropolis. If asked to describe it in one word, resisting the temptation to say "horrible", he would probably choose "changeable" as the word best suited. Indeed, the midwesterner is all too familiar with 70 degree heat followed by 5 degree cold, with June in January and frost in May. Yet while Chicago alternately roasts and freezes or blows away, the senores of Porto Rico, day after day, season after season, almost never see the mercury drop below 70°F or rise above 85°, nor the faithful trade-wind vary from its constant easterly direction.

The association of the concepts "weather" and "fickle" is a middle-latitude prejudice, due to the fact that we live in the battle ground of polar and tropical masses of air, which are brought together with much wind and bluster by the traveling storms or "cyclones". (The November 11, 1940 storm was an outstanding and bloody engagement in this battle.) It is by this continual skirmishing that, in our latitudes, warm air makes its way northward, and cold air invades the southland.

In the tropics, on the other hand, the same transfer of heat can be effected in a more orderly fashion by ascent near the equator and descent in the horse-latitudes (about 30° north and 30° south latitude), somewhat resembling the simple convection cell. That these descending motions at latitude 30° actually occur need not be taken on faith from a textbook, nor are sounding balloons required for their detection. The world-wide belt of deserts—African, Arabian, Californian, and their counterparts in the southern hemisphere—are mute witnesses to air currents warmed and dried by compressive descent. Similarly, the steaming jungle forests of equatorial Congo and Amazon bear telling testimony of abundant rainfall associated with rising air, expanding and cooling to saturation. These clues, and many others, to the atmospheric mysteries lie as much exposed to the curious layman as to the doctor of philosophy, and in this way, the engineering student can be introduced to weather problems.

To supplement this free laboratory of nature whose experiments are put on before our eyes all the time, and whose "data and results" consist of the desert, the towering thunderhead and the blizzard, a man-made laboratory has recently been added to Illinois Tech's meteorology course. By actually swinging a psychrometer (wet-and-dry-bulb thermometers for humidity determination), counting the revolutions of a wind-meter, or locating airmass boundaries (fronts) on a real weather chart, the student learns the use and limitations of the common meteorological tools. He sees the actual operation of many of the principles he heard in the lecture-room. A large section of the lectures, for example, are concerned with the relation between atmospheric pressure and height above the ground. This problem is not only basic to "why the weather" but is fundamental to aircraft altimetry, a topic studied at some length.

What could be a better demonstration of the fact that the pressure decreases upward than the gradual ex-

(Please turn to page 32)

(Continued from page 30)
pansion and final bursting of the huge balloon that carries with it the radiosonde transmitter?

What could be a better indication of the three-dimensional character of our ocean of air than the radiosonde itself, a small, two-pound radio, which, ascending to heights of 50,000 feet and more, sends back to the ground the temperature and humidity at intervals right up into the stratosphere?

What could be a more tangible contact with atmospheric wind-structure than watching radiosonde and balloon ascend, perhaps first toward the south, then reversing, then at greater elevations, almost always veering off towards the east, and finally falling to the fishes of Lake Michigan, or upon the cornfield of a baffled Indiana farmer?

Indeed, the changes of wind with height, the relation between winds and air pressure, and the turbulent wind structure in the lowest levels above the airfield are the meteorological matters of perhaps the most vital concern to aeronautics. It is for this reason that at least one-half of the course is concerned with the many aspects of the subject "wind."

While the wind can often be made to serve the aviator, the thunderstorm, freezing rain, sleet, fog, and driving snow are all his enemies. These hazards to flying, each leaving in its wake wrecked aircraft, cancelled and delayed flights, lost time and money, all arise from the condensation of gaseous water vapor into liquid water (or solid ice or snow). The prime mover in the condensation process is cooling air. In fact, every cloud, whether low and gray and pregnant with snow or white and fluffy, nearly every fog, and every thunderhead, is a sign of this cooling, just as every footprint is a sign that a living creature has passed.

Yet every cloud does not rain. A gray day is not synonymous with umbrella-carrying. To cause a cloud to fall to the ground as rain or snow, something must be added. An additional requirement, that of "supercooling", must nearly always be fulfilled. Even the famous "dry-ice" experiment will not produce rain or snow or anything else unless the cloud so seeded contains liquid water cooled below 32 degrees Fahrenheit. This principle is brought home to the engineering student when in his classroom laboratory he takes on himself the role of snow-maker. With deep-freezer and dry-ice, he reenacts this drama of nature, only too often a mystery that has as its by-products hail, turbulence, icing, thunder and lightning.

As the final phase of their meteorological journey, the Illinois Tech engineers visit the weathermen at work. They invade, for a day, the towers of the University of Chicago, where front-line investigation of instrumentation, theory, and weather-forecasting are going on. They help to send up a radiosonde, and listen at the ground receiver to the putts and hums telling of cloud and temperature direction aloft. They climb around the radio-direction finding equipment (called by meteorologists the "RAWIN"), which, even through rain and overcast, follows the balloon drifting with high-level winds. They visit the hydrodynamics laboratory to see the tiny model of the rotating earth, and how it begins to reproduce, on a small scale, the circulation of the mighty atmosphere.

And during the last week, as a final integration of what they have learned, they see the United States Weather Bureau in operation. They visit the regional forecast center where amid clacking of teletypes and clanging of telephones, the real, bona-fide weather man, the forecaster, does his work, day and night, Sundays and holidays, around the clock. They learn how the data is gathered and watch the decoding of the strange weather-hieroglyphs and the plotting and drawing of weather charts. These are now no longer conglomerates of unfamiliar, mysterious lines and colors, but fog in Omaha, heat wave in Detroit, and the rain right outside the window, this minute, with clearing tomorrow night.

For the student who wrote on his final exam paper, "From what I have learned here about meteorological problems, I can easily see why the Weather Bureau is proud of its 85 per cent forecast record", the purposes of the course have been achieved to a large degree. Although this student, as a graduate engineer, will not thereby achieve a record in forecasting, he will be able to make use of the existing meteorological services. He will have some knowledge of what information is available and how to use it in doing his own job. While the weatherman cannot yet be engineer in his profession, the engineer is more fortunate, for his opportunities to be weatherwise are unlimited.

Author's note:

The writer would like to thank Dr. J. S. Thompson, chairman of the physics department at Illinois Institute of Technology, for making possible the meteorology course described in this article, and for his continued support, interest, and large fund of helpful ideas. Gratitude is also due to the many students who participated in the growth of the program, and whose reactions, suggestions and criticisms have now become an integral part of it.

Research Facilities in Illinois

(Continued from page 17)

It can be readily seen that two out of three of the sources of research funds, i.e.. industry and government, are inherently harnessed with an influence to direct the research into applied fields rather than toward exploratory investigations.

Where does this leave us?

Our most able scientists have told us repeatedly that the pace of using our store of knowledge has in the past decade far exceeded our efforts to refill that storehouse. The figures given in the Steelman report shows this to be true in this country at least. In 1937 there were 35,000 scientists in the universities and 22,000 in industry, while in 1945 there were 36,000 in the universities as compared to 57,000 in industry — a definite trend of from 50 per cent to 28 per cent on fundamental studies, if we use this division as a rough guide.

The crying need, at this time, is for more support of exploratory investigations; the applied research pays dividends and will look after itself.

Some Figures on Illinois Research

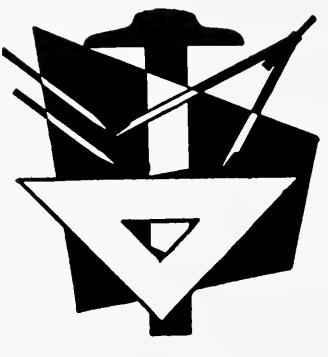
Let's make, at this point a brief and, admittedly, an incomplete summary of the research facilities in Illinois.

We find that in the state of Illinois there are 358 industrial research laboratories, 11 colleges, 6 universities, 242 miscellaneous testing laboratories, which maintain research programs, and several federal government laboratories. It is estimated that there are approximately 14,000 persons engaged in research of one kind or another in our state. This figure may be broken down in groups as follows:

Administrative	*700*
Chemists	*2310*
Engineers	*2150*
Metallurgists	*360*
Technicians	*2900*
Geologists	*10*
Physicists	*425*
Biologists	*75*
Bacteriologists	*50*
Clerical, Maintenance	*3020*
Total	*12,000*

Research activities extend into many branches of science and industry. Research in chemistry and in the other physical sciences and in the biological sciences is probably most prominently before the public mind, but research methods are being applied also in the social sciences.

It will be seen that industry itself conducts a major proportion of the research, especially that which is directly applicable to its problems. Universities and colleges are the source of most of



the fundamental research. National and state-supported institutions and experiment stations, as well as consulting firms and institutes, engage in both fundamental and applied studies.

There are 27 commercial laboratories in Illinois offering services to individuals in industry; 25 of these laboratories are in Chicago, one in Cairo, and one in Quincy. The same type service is rendered by 9 colleges: Chicago four, Bloomington one, Evanston one, Monmouth one, Naperville one, and Urbana one.

As you know, Armour Research Foundation of Illinois Institute of Technology is the second largest independent organization in the world and the only one with an international division offering world wide research facilities. It has a total of 538 full time employees, of which 325 are full scientists. It has no endowment and is also a non-profit organization rendering a service to industry.

Research in Agriculture

Prominent in the research work of the University of Illinois, its Agricultural Experiment station, and of a number of industrial concerns is the extensive research upon agricultural methods, materials, and products. For instance, apple orchard fertilization was begun over 30 years ago. We hear frequently, over the radio, advice concerning soil conservation, poultry production, animal husbandry, and related items. Manufacturers of feeds, fertilizers, insecticides, and farm machinery, together with processors of farm products, all sponsor and conduct research for the improvement of agricultural products and at greater profits.

Research in Petroleum

Turning to research conducted by industrial organizations, the nearby oil refineries at Whiting, Indiana, may reasonably be considered as part of the Illinois Manufacturing area. The new research laboratories of the Standard Oil Company of Indiana have been estimated to have cost about \$10,000,000 and to cost annually about \$6,000,000 to maintain and operate.

The Sinclair Refining company is building a new research and development laboratory at Harvey, Illinois, to cost about \$4,000,000, and the Pure Oil company is to build a research laboratory on a somewhat equivalent scale northwest of Chicago.

The Universal Oil Products company at Riverside has occupied a position of international leadership for many years.

Research in Food and Nutrition

The food industry and related industries in Chicago include such firms and trade associations having research laboratories as American Meat Institute, American Can company, Armour & Company, Continental Can company, Corn Products Refining company, Griffith Laboratories, Kraft Cheese company, Quaker Oats company, Swift & Company, Victor Chemical Works, Visking Corporation, and many others, and such pharmaceutical firms as Abbott Laboratories, Bauer & Black, John-

(Please turn to page 36)

(Continued from page 34)
son & Johnson, G. D. Searle & company, and Wilson Laboratories. The laboratories of the American Medical Association and the American Dental Association should be mentioned. as well as those of the principal hospitals.

Research in Various Fields

In a completely different field, that of the metals, there are the laboratories of such concerns as Carnegie-Illinois Steel company, Inland Steel company, and Fansteel Metallurgical Corporation. Of these, Inland and Fansteel do their rather extensive research here. Carnegie-Illinois shares in the entire research of U. S. Steel Corporation.

Then there are the Sherwin-Williams Company and the Glidden Company, as well as other surface coating manufacturers.

There seems to be relatively little local research on rubber and related materials.

Most of the manufacturing and research activities in Illinois are concentrated in Chicago. Attention should be given also to such organizations as the Northern Regional Laboratory, U.S.-D.A., at Peoria, and the Food and Container Institute in Chicago.

Research Fellowships, Scholarships, and Grants

In *Chemical & Engineering News* (1946), Hull and Timms of the National Research Council published a list of research scholarships, fellowships, and grants supported by industry. Twenty-four firms whose headquarters are in Illinois are listed as contributing over $530,000 for this purpose. Nine other firms (including Swift, Fansteel, Searle, Stange, Hiram Walker, the Portland Cement Association, Cast Iron Pipe Research Association, Elgin National Watch, National Livestock and Meat Board) also support such research, but the amounts are not stated. In our own case this totals more than a million dollars during the past seven years.

Besides these, there are nation-wide organizations having large units in Illinois which contribute over $825,000 for such research. Among the larger contributions are:

Bituminous Coal Research. . . .
. . . . over $500,000
American Petroleum Institute. .
. . . . 218,000
National Canners Association. .
. . . . 22,300

This raises the question of financial support of large scale research.

The popular conception is that scientific research is such productive effort that there should be no limit to its support. The popular fancy says that if a billion dollars will produce such wonders, let's spend two billion and double the wonders. Now let's take a sane look at the picture and see what effect is produced by a large appropriation to support research in some particular area of human interest.

In the first place, there is a limited number of scientific workers available and more dollars will not make more scientists — at least not this year or next. To pour money into one area of
(Please turn to page 38)

Machines in RCA's Lancaster Tube Plant are designed for mass production of Kinescopes—television picture tubes—at lowest possible cost.

(Continued from page 36)
research simply attracts the workers out of some other area where there is already a scarcity and where the need is equally great. Thus, a scientist may interrupt important work to move to a more lucrative position and start on a new project no more important than the one he left. The fund thus becomes a haphazard system of allocating our scientific talent, the most precious resource in the world today.

In the second place, the training of scientific workers is behind schedule due partly to the effect of an unwise draft law. This deficit is further aggravated by unwise appropriations which have drawn many of the best university scientists out of their chosen profession into other jobs, and this depletetd the university teaching staff below the point of effective work.

A third point that needs only to be mentioned is the effect of up-grading many civil service workers beyond their capacity. There are numerous illustrations of the establishment of new divisions or laboratories of government bureaus robbing other divisions of members of their working staff who become group leaders or division chiefs. This leaves the first bureau understaffed and provides, in more than one instance, a research director who is not fully competent on the new job.

It seems perfectly clear that some of the new appropriations could have been spent to better advantage in raising the salaries of these university professors or government civil service scientists on the jobs which they already held and which, in many cases, they were more competent to perform.

Industry has been accused of interfering with the training of badly needed men by hiring the teachers. I have no doubt that there may be justification for this charge, but I am quite sure much more damage has been done by indiscriminate appropriation from uninformed congressmen and the accumulation of huge funds by popular subscription of dimes to a cause which has been blandly overemphasized in its relative importance. I cannot emphasize too strongly my feeling of the unsoundness of this slipshod method of supporting scientific research.

We have organized our charity in this country through the Red Cross, the Community Fund, and other organizations, to assure sound administration. Why can't we similarly organize our impulse to support scientific investigations so that the administrators will utilize our money, and more important, the manpower of our scientists, to the best advantage? To popularize the need for research in one area to the extent that its support indirectly detracts from the effective work in another area may render a disservice to humanity.

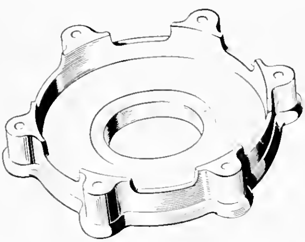
There is a popular demand for the establishment of a National Science Foundation and such a bill was passed by the House and Senate last year, but vetoed by the President. I have studied this subject as best I could,
(Please turn to page 40)

BUSINESS IN MOTION

To our Colleagues in American Business . . .

Here is another example of the fact that the cost of material per pound is not so significant as the cost of the finished part or product made out of it. In fact, judging material costs on a cents-per-pound basis may be completely misleading.

Revere during the war was asked by the government to apply its long experience with copper and brass to the manufacture of mill products in aluminum. It has remained in the aluminum business, making tubing, extruded shapes, and forgings. The latter naturally are custom-made to special designs. One of these seemed interesting to us, and the customer was asked if he would care to provide facts and figures that would show why he found it economical to choose an aluminum forging for this machine part.



He told us that he originally made this out of cast iron, which is, of course, an inexpensive material. An aluminum forging naturally costs more than an iron casting, in this case 5.2% extra. That would seem to be a big handicap to overcome, but a number of important savings when totaled together showed that this "costly" forging was actually saving considerable sums.

For example, the iron casting was ⅛ inch oversize on top and bottom, to allow for machining; the aluminum forging is so accurate to dimensions that only 1/32 inch is allowed for machining. This means 75% less stock is removed when machining the two faces.

Machining cost is 75% less than on the iron casting, this figure including a loss of 10% of the castings due to defects uncovered by machining. Since the forging is dense and uniform, free from porosities, it is unnecessary to pressure-test it to make certain of its quality. This pressure test of the casting was an expensive process in terms of labor costs and time consumed. Doing away with it not only reduced costs but speeded up production. When all the figures were in, it was found that this forging which was 5.2% more expensive actually cost 35.4% less as a finished part. And it was a better part, too, in every way.

If you are making or buying castings, Revere suggests that you investigate forgings. They have many structural advantages, and, as this example shows, may also offer economies. In fact, no matter what you make or buy, Revere recommends that you disregard the initial cost of materials. It may very well be that a more expensive material is less costly in the end and will not only save money but improve your product's appeal to your market. One final thought — suppliers to every industry will be delighted to collaborate with you in your studies of this subject. Why not call them in and add their knowledge to your own?

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

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Executive Offices:

230 Park Avenue, New York 17, N. Y.

(Continued from page 38)

but frankly I do not know whether it should become law or not. I'm sure of one thing—the President's reasons for vetoing it were wrong. He wanted more government control and if there is anything that will make it turn out badly, it will be government control which is subject to political maneuvering. There seems to be little doubt that we need to encourage more exploratory research. The applied research on peace time objectives will take care of itself because it is profitable and, as we said before, the profit motive will make it work to the benefit of everyone.

Now, the question is, how can we encourage this exploratory or fundamental research to the best avdantage? The most important rule is to let the scientist work along those lines which attract his interest. The second rule is to provide such financial support as his individual competence seems to justify, and the third rule is, not to allow the source of these funds or any other influence to restrict his scientific inquiry.

We have listed some of the restricting influences of both government and industry. To overcome these hurdles in a government supported program seems almost impossible. The income from independent private foundations is limited and there seems little chance that it can be increased or even replaced when the present foundations have expired. For the sake of keeping the record clear, however, and to help clarify our thinking on the subject, we should acknowledge our debt to these foundations for their past and present performance. They have been outstanding in accomplishing their objective to the extent of their resources.

Now, if the private foundations have reached their limits and the government is too enmeshed in political pressure, where is this all-important support, with freedom, to come from, except industry?

We mentioned earlier the gradual acceptance by industry of a responsibility for basic research. This is evidenced by ever increasing amounts of money expended by industry for grants-in-aid to basic research. It is true that this increase has taken place in a period of post-war prosperity but the important point is that industrial leaders have recognized a responsibility. A second point of even more importance is that industry has found a way to place these grants with wisdom and yet without exerting pressure on the scientific worker either as to the selection of his project or the course of his investigation. This is at least one step ahead of government money.

The need for exploratory research and for basic research in specific fields is so important that it must find more encouragement. In my opinion, this can come only from the current earnings of industry if it is to accomplish the objective outlined. Several plans have been tried by industry in working out the best method of providing this support without violating any of the rules. Some of these have worked very well and others have been only half effective.

Suppose an individual company arranges for research in some university on the basic elements of some problem of interest to the company. Insofar as this is also the interest of the scientist and insofar as the company follows a hands-off policy, this may be satisfactory for the purpose under discussion. If, however, the funds were so enticing that they caused the scientist to change his field of investigation, or, if the company influenced the work toward practical solution of one of its problems, the effect would be opposed to this objective. It might result in some important practical discovery, but it would have taken a competent man out of the field of his basic research where there is the greatest need.

The problem of placing grants-in-aid to research is not always easy to do wisely. It requires a very considerable amount of study by competent scientific administrators to appraise the scientific workers and their facilities for carrying on the proposed project. To scatter the funds indiscriminately might provide plenty of freedom but certainly would lack wisdom. It is difficult for the technical staff of one company to make a thorough appraisal unless it was deliberately organized for the purpose. For this reason there is much in favor of working grants through some recognized channel such as the National Research Council or the scientific committee of a trade association. If a large number of the members of a trade association are interested in supporting such a

program it can work out quite well. Good examples are the National Canners Association, the Refrigeration Research Foundation, the Sugar Research Foundation, Corn Industries Research Foundation, and others.

Another plan which provides the advantages of group support, and which is on a somewhat broader base than the trade associations, is that worked out by the food industry in the form of The Nutrition Foundation.

If there is any activity of man which is completely international in nature, it is science and scientific research. They know no boundary of state or nation.

But, the technique and method of science can be learned and developed only to the extent that freedom exists among the people. It is not enough to set aside a few thousand chosen people and give them freedom and support for research. These few people may become very adept at scientific work but the contributions of a few thousand, or, even a hundred thousand people would be insignificant compared with the works of a nation where *all* of the people have the freedom to embrace the scientific method. Real freedom as we have known it in this country provides something more than the right to build a new machine or to react two reagents to produce a new product. It provides the incentive: without that incentive people will not go to the trouble of creating these new things.

In a recent editorial, Dr. Robert Milliken, one time Nobel prize winner in physics, is reported to have said, in reference to our atomic bomb development, that new standards of precision had to be obtained and that we had to compress into four or five years the engineering progress of a normal two generations. That, he says, is the actual secret of the atomic bomb, and it cannot be duplicated except by a nation with a horde of trained technicians.

In a recent talk by Eugene Holman, president of the Standard Oil Company of New Jersey, before the Economics Club of New York, it was pointed out that raw materials for industrial development exist in many parts of the world to an extent equal or greater than they do in the United States, yet the people in these places have made little headway in their development. The difference, he says, is that resources are not *found*,—they are *made*. Why have they been made in this country? You know the answer: it is because of our traditional recognition of the right of ownership in that which is created. This is the incentive for man to experiment, reason and create. To the extent that we break down the right of individual ownership, either through the planned economy of a totalitarian state, or through excessive taxation, just to that extent will we destroy the forces which have made our country great and which can, with continued freedom, make it even greater beyond comparison.

Sports and Illinois Tech

(*Continued from page 14*)

much practical use, to be found during, rather than after, the actual participation. For the human being, the absorption, the complete effort, is an expression of himself, just as surely as the beautiful sonnet is an expression of the poet and the piano concerto is an expression of the composer. If these things seem to possess no other value in a material world, they possess a certain unmistakable value in themselves. The individual who can express himself in some desirable, or not undesirable, fashion, is a happier, fuller, richer person.

It is indeed true that participation in sports, with the concomitant desire to win, will not invariably bring about these ends of which we have been speaking. In fact, in its present condition, intercollegiate athletics can easily boomerang to set examples and teach lessons which most of us feel are harmful. We shall discuss the evils later. But supposing the person grants that athletic participation is primarily a good thing for the human being, the nation, and the world; he may still have some questions to ask. Since such a small percentage of the student population participates in intercollegiate sports, he will probably argue, why not eliminate them altogether and concentrate upon and expand the intramural athletic program?

Actually, there may be no answer to satisfy some of the critics of intercollegiate athletics. Unless one is a lover of sports for the sake of sport, as one is a lover of dogs or horses, or of stamps or antiques, he may be inclined to look at the evils that have arisen from the commercialization of college athletics and feel that it is not worth spending the effort to eradicate them; let's just abolish the whole thing, he may suggest. However, I for one, and probably most of you, would feel a definite loss if intercollegiate competition were done away with. But a little more objectively, let us look at some of the probable benefits from the standpoint of the athlete, those who watch him, and the school he represents.

Intercollegiate sports pit the superior athlete, or the athlete who is at least somewhat more skilled than the average young man, against competition of his calibre; they provide a greater challenge; they give a greater satisfaction in accomplishment; they intensify the spirit of the game. Generally speaking, most all of those values already listed are better realized through intercollegiate competition. For the student, intercollegiate athletics are a refreshing interlude in the day-to-day routine of college life; they provide an opportunity for emotional release; they create a pride in and devotion to one's own school. For the faculty and staff member, practically the same is true; and, in addition, an interest in sports as a fan helps keep that faculty or staff member from becoming too staid and too stately. Certainly there are those persons in almost any institution who are guilty of such faults; in a position where one either deals directly with young people, or, in general, works for the ultimate benefit of young people, these faults are especially undesirable. For the alumnus, following the activities of his school's athletic teams can be one of the strongest bonds to the old college. His former classmates may have separated; his former instructors may have died, retired, or moved on; the very buildings and landmarks that to him were "college" may now be replaced. But he can still belong in some ways: in one, by taking the team's wins and losses almost as seriously as his own. For the fan outside the school, college sports produce a peculiar devotion to the adopted school and provide an excitement and glamour that no professional sport except major league baseball seems able to give. And for the institution itself, each of

(*Please turn to page 44*)

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these benefits to the various individuals is usually a benefit to the school.

Not long ago *The New Yorker* printed a droll piece describing the downfall of college football in something like 1998. It seemed that the game had gotten so far out of the hands of the students that the athletes themselves were eliminated altogether. On Saturday afternoon two football strategists would get together over a paper gridiron and manipulate their 11 pawns, while a referee stood by and determined the distance gained on each play by taking into account the offensive and defensive strategies employed. Meanwhile, a late-twentieth century facsimile of Bill Stern piped an account of the match, with appropriate recorded cheers in the background, to the fans of the nation, who, of course, had their parley cards close at hand. But a dozen or so college boys, sitting in their dormitory, were bored with it all. So they grabbed a football, went out into an empty lot, and kicked it around. They had a grand time. Then, a couple of weeks later the boys challenged a group of lads from a neighboring school to a football match. And the cycle was begun again.

There is little doubt that the cycle would begin again, and most of the present evils would again attend the subsequent development. To the people in the country who are genuinely fond of intercollegiate athletics, the job is to eliminate as many of these evils as it is possible, to keep college sport for those who feel it rather than for those who exploit it.

If there were no reason at all for intercollegiate athletics, there would still be rhyme. To many of us it seems that the world is slowly, or perhaps rapidly, burying itself in its own pragmatism. So few things are granted existence for their own sakes; everything, some thinkers seem to tell us, must serve some practical or material end. I think that if we look very deeply into this pragmatic thought, we will find that it is directly opposed to the philosophy that is supposed to be ours in this nation, and that it is pretty much the heart and spirit of the totalitarianism we profess to hate.

A Look Backward and Forward

In June, 1947, Edward W. Glancy of Pawtucket, R.I., was appointed varsity basketball and baseball coach and director of intramural sports. Glancy had served at Illinois Tech as an ensign in the Navy athletic program during the war.

The new coach succeeded Bernard "Sonny" Weissman, personable assistant director of athletics and institution at Illinois Tech, who filled in as basketball and baseball coach for two years. Sonny was able then to go back to his first loves, wrestling and boxing, and to his administrative duties.

An excellent athlete himself (he was an all-Metropolitan basketball star while attending Manhattan university in the late thirties, and later he spent several years in both professional basketball and baseball), Glancy brought with him a brilliant high school coaching record. However, he inherited just four members of the previous Illinois Tech squad, which had managed to win only four of 18 games; and just one of these four veterans proved to be of much help. Glancy built around some fairly promising but very green freshmen and sophomores. It was a better team than its record of five wins and 13 losses would lead one to believe. The Techawks lost one game by two points, one by three points, and one by four points, and in several of their early season defeats kicked away substantial second-half leads. Inexperience was most to blame for these latter disasters. Glancy's lads won four of their last 10 games and late in the season gave both St. Ambrose of Davenport, Iowa, and Kenyon of Gambier, Ohio — two of the finest teams among midwestern small colleges — terrific fights to the very end.

It should be a better basketball team on the floor this winter. Practically the entire 1947-48 squad is returning, and one year's added experience will surely not hurt. The 1948-49 Techawks, however, will be tackling a much more ambitious schedule. Glancy has arranged games with DePaul and Loyola — almost always among the toughest in the nation — and Wayne university of Detroit.

"We may be presumptuous," the genial Mr. Glancy says, "but we're stepping up a notch or two." He, of course, does not expect to come out with a triumph in any of these bold ventures. He would settle for a "moral victory" in one of them.

The Illinois Tech Relays remain the largest indoor track meet in America.

The Illinois Tech coach is young (he is 30), popular, enthusiastic, and very capable. If he has his way, Illinois Tech will no longer be a morale builder for most of the other smaller college basketball teams in the vicinity. He knows his job is an especially difficult one, with standards as high and demands upon the student as great as they are at Illinois Tech, but he wants a winner. With reasonable luck, he will get one.

The baseball and track revivals are more or less following the same pattern. The emphasis was on freshmen and sophomores who showed enough to brighten some otherwise dreary moments. The baseball team, as a matter of fact, closed its season rather sensationally with four straight victories, after a very dismal start. The season's record came to a respectable six wins and seven losses. And Glancy's two best batters and his one very promising pitcher were freshmen.

The track team, under Roy B. McCauley, failed to score in its own relay games and in general did not startle the track world, but most of McCauley's better point getters were first or second year men, and energetic Roy looks to a happier spring in 1949. The Techawks did salvage a few dual meets

and managed to give DePaul a very torrid time of it before losing by slim margins on two occasions.

In the so-called "minor" sports — swimming, boxing, wrestling, fencing, tennis, and golf — Illinois Tech won more than its share. Paul Hermann's tennis team, as strong as usual, swept its last six matches and ended with eight wins and four defeats. The golfers, under Sam Bibb, beat Bradley, Loyola, and Chicago, among others, and a freshman led them most of the season. John Ahern uncovered two potential stars among his freshmen swimmers and they helped the Techawks to a successful season. One of Sonny Weissman's wrestlers — who enjoyed another good year — just missed qualifying for the AAU finals. And the boxers, under Weissman and Jim Ladd, again sent a squad to the Golden Gloves tournaments.

The Seventeenth Annual Illinois Tech Relay Games, held March 13 in the Chicago Fieldhouse, were again run off before a capacity house. More than 750 athletes from 70 universities, colleges, junior colleges, and high schools participated. The Illinois Tech affair remains the largest indoor meet in the nation; when the contemplated field house is constructed it will have a home on the campus for the first time in its history.

The Institute added a second big sports promotion last winter. Early in November the University of Chicago abandoned its holiday basketball tournament for Chicago public high schools (formerly, the Stagg tournament), and a few weeks later John Schommer announced that Illinois Tech would replace that tourney with one of its own at the International Amphitheatre. With the Chicago decision to drop the meet, a number of the high schools made other commitments for the holiday week. This cut the field somewhat and eliminated a few of the larger schools, but nevertheless, 28 teams entered and the quality of play was still very good. Marshall, the school that took the first Illinois Tech championship, moved on to capture the City title and then won its first contest in the State tournament at Champaign. Fans, participants, coaches, and writers very definitely liked the way the new tournament was handled. With much more time to prepare for it this winter, the Second Annual will be an even bigger thing.

A Difficult Situation

It is, of course, no coincidence that year after year Illinois Tech manages to turn out fairly strong varsity teams in the "minor" sports while the basketball, baseball, and track teams it produces are not often in a class with teams from schools of a comparable size. High school basketball, baseball, and track stars are scouted by the more sports-minded universities and colleges almost as thoroughly as their fellow heroes on the football field, and not many of the better performers slip

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through such eager fingers. High school fencers, wrestlers, and the like, however, are pretty well ignored; they generally end up at the school of their choice, usually without concessions of any sort.

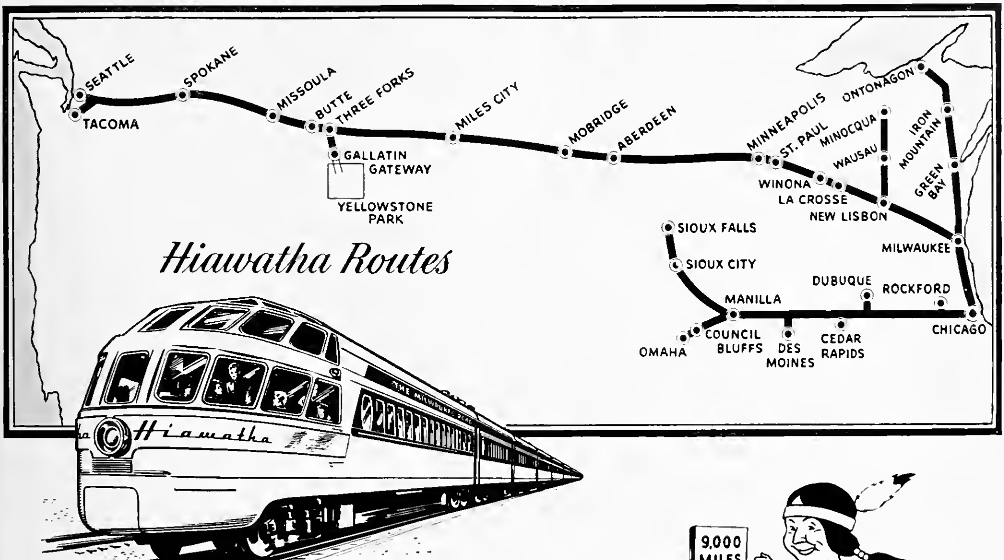
This is a difficult situation to buck — for Illinois Tech and for schools like Illinois Tech who want winning teams but refuse to compromise their ideals in any way to procure these winning teams. In the 1920's and the earlier 1930's, the Techawks (then representing Armour Tech) were generally among the toughest in the neighborhood in their three "major" sports, but in the later 1930's, some 10 or 15 years behind football, basketball, baseball, and track got caught in the college emphasis, and Illinois Tech was left behind. During the war, navy trainees helped give the Techawks some very fine varsity athletic teams; but the war is over now, and that source of athletic talent is gone.

The boys who are directing the sports revival at Illinois Tech — John Schommer, Sonny Weissman, and Ed Glancy — know the problem better than any of us. They acknowledge that it is a difficult situation, but not an impossible one. And the administration of Illinois Tech is behind them.

From President Heald down to the lowest rung on the administrative ladder, the Institute wants an intercollegiate sports program of which its students can be proud. But it positively will not commercialize or subsidize to obtain better athletic teams. The sports revival is being and must continue to be managed within the ideals of the college. The person who feels that Illinois Tech should veer even slightly from this policy does not understand the purposes of the Institute.

The big question then is: can Illinois Tech stay within its ideals and still produce these better teams. Schommer, Weissman, and Glancy believe that it can.

(In the December issue, the present evils of intercollegiate athletics, the steps Illinois Tech can take to further its sports revival, and the possibility of a football team at Illinois Tech will be discussed.)



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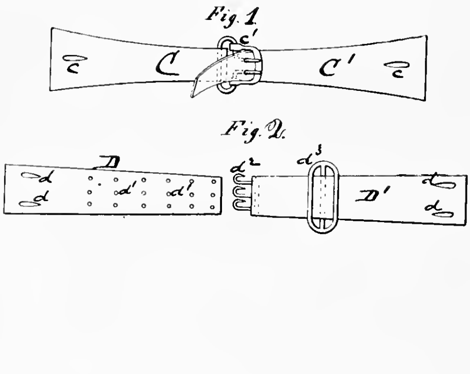

Witnesses:

Henry A. Miller

C. L. Evert.

Inventor

Saml. L. Clemens

per Alexander & Mason

Attorneys.

Mark Twain . . .

(Continued from page 20)

the entertainment of his children, finally reached such proportions in his mind that he conceived it as taking the country by storm. The game was to deal with the various periods in English history, and his notebooks and letters of this period are full of ideas concerning it. Fragments interlock to give substance to these ideas, with comments such as, "A playing-board connected with or punched through with dates in the world's history, and some after each ruler." At another point he wrote, "Chart for empire. Has dates and color arrangement corresponding with playing board." As with his other ideas, Twain felt that this one should be carried to a state of high perfection, and soon he reached an impasse in that his game had become too complicated for practical use. Losing interest in this brain child, he turned his fertile imagination to other fields.

He was not above trying his hand at personal items. In his *Autobiography* we find this comment, "Then I put on my shirt. My shirts are inventions of my own. They open up the back and are buttoned there—when there are buttons." In 1873 he patented his idea for an adjustable and detachable strap for garments. Then too, his growing family presented to him problems for his inventive genius. One such idea was for a device to keep children from kicking off their bed-clothes or rolling out of bed. There was such an article on the market at the time, and Twain wrote in one of his letters, "We use it all the time now, on three beds, and it works all right." But Twain had a better idea, and besides the article sold too cheaply, retailing at from $.90 to $1.15. Twain invented a more expensive and, to his way of thinking, much better bed clamp. "Even $2 is much too low for the bed-clamp," he wrote. "If I go into it eventually, it must be at $2.25 each for the small size and $3.00 for the large." The matter of supply and demand was a minor item in the economic thinking of Mark Twain. He probably calculated that all the babies born each year would use his new invention and went on, in his dreams, to build a substantial income for himself without any regard for the fact that few young parents could afford his deluxe item.

In his notebooks Twain recorded an idea which was left to be developed beyond the thought stage by other minds. "I think I have a good idea," he wrote. "It is to reduce a series of big maps to mere photographic fly-specks and to sell them, together with a microscope of one quarter to one inch focal distance." He never followed the idea through, but its essence was utilized in the late World War when maps were reduced photographically to a size so small that they could be concealed in such unlikely places as between the glass and the rims of a pair of spectacles.

Toward the end of a busy career, while traveling in Europe in 1898,

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Twain became interested in a carpet-designing machine in Vienna. Whether by accident or by intent, it was arranged that he learn that the American patent rights to the machine, the Szczepanik patent, were available. Immediately he became interested in its possibilities which, to his mind, were particularly alluring. He probably envisioned revolutionizing the carpet-making industry, a premise that was confirmed in his mind when he was approached by a person representing himself as the agent of certain American carpet-making interests. The agent inquired what price Twain would take for his option. At this time Twain was engaged in recouping his personal fortune after some disastrous business ventures and had as his financial adviser an able banker, one H. H. Rogers. Twain hastened to cable Mr. Rogers in America about his new find and his option, but evidently Mr. Rogers was not sufficiently impressed, even with the price of $1,500,000 set upon the patent rights, to either invest in his own right or to allow Twain to do so.

Although Mark Twain, in his writings, poked fun at the cousin who served as the model for his famous character Colonel Sellers, the man who always believed his ideas had "millions in them," still he was an inveterate backer of new inventions, most of which failed completely at large financial losses to him. His own inventions, interesting in themselves, are the curious outgrowth of a highly creative mind. This phase of Samuel Clemens' life is completely overshadowed, and rightly so, by the brilliant and ever-living creations of his pen in the realm of fiction.

Hermann Hesse . . .

(Continued from page 11)

way of the hero is wrong, the direction toward which he wanders is wrong, his goal is wrong. New ways have to be found. New books have to be written in order to find the way "toward home." It is quite different in Hesse's works. His hero, Knulp, wanders into the right direction and reaches the right goal. He receives the blessings of the Lord and is a part of Him.

During the years of the First World War, this word "home" was re-interpreted. Which "home" is the goal? Where is that home? This searching, struggling new spirit is mirrored in *Demian*, a novel which was published in 1919. Demian recognizes that his "home," as he sees it as a youth, really consists of two worlds—one light and the other dark; "This light world was for the greatest part known to me; it was called Mother and Father, it was called love and strength, good example and school. To this world belonged a mild glamor, brightness, and cleanliness; here were friendly chats, clean hands, clean clothes, and here were good morals. Here a morning hymn was sung, here Christmas was celebrated. But the other world, the dark one, goes right through this clear and clean, this beautiful and orderly world of the light. It is that darkness in which there are maids and wandering apprentices, ghost stories and scandals and rumors, stories about drunkards, killings, jail, and suicide. It was very strange," the author reminisces, "that there at home was peace, order and calm, duty and good conscience, pardon and love; and it was wonderful," he adds, "that at the same time there was the other world, in which there was the loud and the sombre and the cruel."

These remarks sound quite unusual from Hesse, who comes from an old family of missionaries. But it is the reason that he himself did not stay with the ministry which he had started at Maulbronn in Germany, and had discontinued, to the sorrow of his family. Hesse could not condemn the dark world as a part of the evil, the devil. His hero Demian knows about old religions and philosophies of India and of early Christianity which did not condemn that other part of "home." He says to his friend Sinclair: "I think we should love and worship the whole world, not only that artificially divorced, that official part! Therefore, we should place a service for the devil beside the service for God. That would be right, in my thinking. Or, we ought to create a God who also includes the devil in himself, and before whom one would not have to close one's eyes when the most natural things of the world have just taken place."

This taking upon oneself the whole world, the good as well as the evil, was Hesse's way out of the chaos created by war. It gave him the strength to retain his love for his home in which he found particles of the light and the sombre. Hesse knows that the acceptance of that creed is not easy for most people, as it was not easy for him. He describes the situation of having to fight the stubborn resistance of his family when he left Maulbronn: "The bird fights its way out of the egg. He who wishes to be born again has to destroy a world. The bird flies to God. God is called 'Abraxas'." The destruction of the eggshell was Hesse's destruction of the bour-

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(Continued from page 50)

geois world, out of which he came himself, but which, as he believed (like such contemporaries as Werfel, Hauptmann, Mann) forced the human being into a state of comfort, hypocrisy, and uncertainty. He arrived at this conclusion because he was constantly aware of the presence of the other part of the world, which the bourgeois did not want to see or which he labeled as "sinful" if he noticed its existence at all. The bourgeois was forced to join masses and crowds to enjoy being blind among the blind.

This desire for destruction of the bougeois world was, at that time, quite in fashion, particularly among the intellectuals and artists on the continent. The man who had ignited that flame was Friedrich Nietzsche, with his teaching of the transformation of human desires into powerful forces of any kind which would not be "wrong" or "bad" or "sinful" if their power had creative strength.

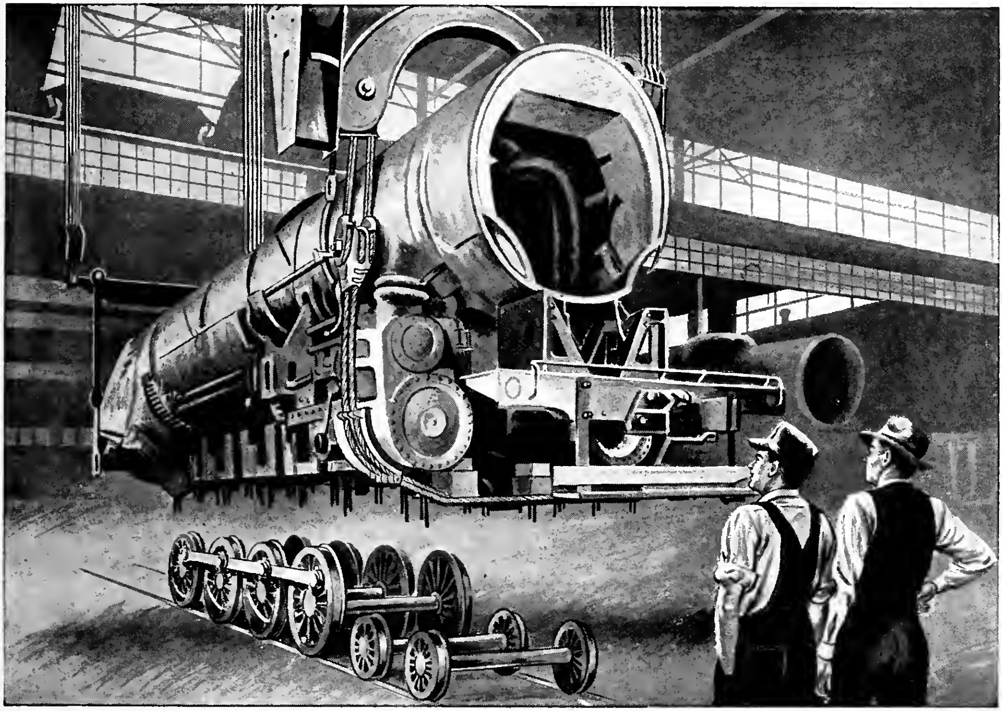
At that time a great destruction of most values of the bourgeois world set in, and German literature shows evidence of that destruction; particularly of the attempt to destroy the God of the Christian interpretation. Hesse was less forceful in emphasizing the destruction of old values than he was in stressing the new findings. His new God was Abraxas, God and devil in one, desire and fulfillment in one, man and woman in one.

It should be stressed that this conception of God was not a mere fiction invented by the author himself. The myth of Abraxas is of Gnostic origin. Gnosticism gives evidence of religious phenomena (Urerlebnisse) and had threatened early Christianity. It was nothing else but a renaissance of Greek religiosity and stemmed directly from old antique mysteries. Quite a few such cults were active at the time of the early Christian era, and they varied in stressing different forms of human emotions. Christian and pagan elements were interwoven. Dionysiac ecstasy, prophesy, and black magic often found a home among Gnostics. But there was one common factor which tied all of these various groups together: their belief that there is no dualism between the spirit and the matter; that the one and only stream of the divine flows through all existence.

Among famous Gnostics we find Basilides, who lived in Egypt at the time of Hadrian. He called the creative power which penetrates every cell of life "Abraxas." In the work of Hesse, this God Abraxas is the God of the non-bourgeois, different for each individual. On the way to him, the individual will find his own inner self, the things permitted him, the things denied him. He will find that each Abraxas-human has his own laws and morals to discover and to guard. "Abraxas has nothing against your own thoughts, against your own dreams. But he will leave you at once if you become orderly and normal again. Then he will leave you and will search for a new pot in which to

(Please turn to page 54)

These live lines are cheaper than headlines



Guy de Maupassant's classic about the Frenchman whose mania for saving string brought ruin upon him, is an object lesson for wire rope users.

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(Continued from page 52)
boil his thoughts."

Consequently, it is not surprising to note that Hesse often longed for India, where his forefathers had been missionaries and which he himself learned to know, after he had given up his job as a book seller when his first books began to return steady royalties. In India's Brahman philosophy, he found something akin to his belief in Abraxas. Siddharta, the hero of his next novel (published in 1927 under the same title, *Siddharta*) is on the search to find eternal happiness. He leaves his home and takes a pilgrimage to Buddha. He sees him and recognizes in him the greatness of divinity, but he leaves him again because he cannot believe in gaining happiness through discipleship, through turning one's back to the "other" part of the world. Siddharta then experiences that other part of the world of his own will. He particularly experiences its darkest sides — business, money, and vice — but finally retires at the end of his life as a ferry-man on a big river. Through the acceptance of life as it confronts him, he becomes a saintly person much like Saint Francis, or perhaps more like the Prince in Dostoevski's *The Idiot.*

Dostoevski's influence becomes still more evident in *The Wolf of the Steppes* (1927). The women strongly suggest the ones in Dostoevski's novels. Harry, the wolf of the steppes, because he stands outside the bourgeois world and habits, experiences the world in all its layers, particularly its lower ones, in order to find the way to some happiness. On his search he meets the prostitute Hermine, who in her simple, childlike way, in her adoration of the saints, in her acceptance of good and bad as it comes along, could easily have lived in St. Petersburg at the time of Dostoevski. There is a saintly air about her when she says to Harry: "We have to step through so much dirt and nonsense in order to reach home. And we have no one who would lead us; our only guide is our longing for home." That assumption that there is a bit of holiness in each person, including prostitutes, was also Dostoevski's belief eagerly shared by the Abraxas-author Hesse.

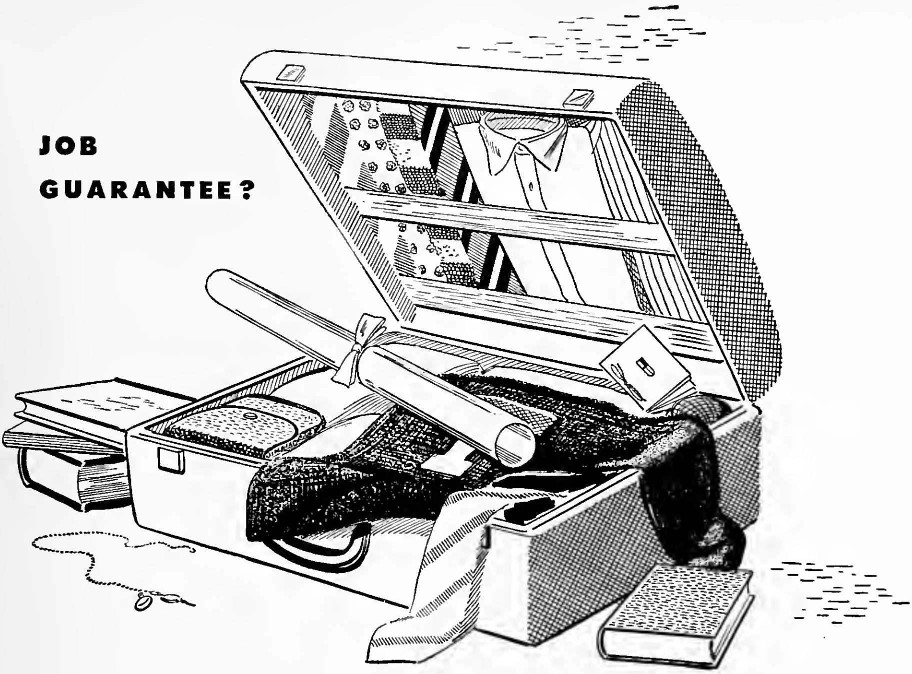
Thus the polarity of life, the tension between day and night, good and evil, life and death is being recognized and accepted in Hesse's novels. In his thinking, a great man will harmonize that polarity, he will no longer judge, he will accept and act like Gotama or Saint Francis.

In 1932, after Hesse had moved to Switzerland, he published a rather difficult novel which reads like an old fairy tale because of its many symbolic motifs and its romantic language. Its title, *Pilgrims to the Orient,* indicates that here a whole group of people is being examined, not merely one or two main characters as before. The "pilgrims" are those searching men who are on their way "home", and Novalis's phrase about "always going home" is used by Hesse as a motto for this new novel. Of course, the Orient is not meant to be the Orient of the map: "Our Orient was indeed not a country or something geographical; it was the home and youth of our soul; it was the everywhere and the nothing; it was the unification of all times."

These men, on the pilgrim search for happiness, wander only a very short stretch together and then quarrel. Desertion begins. All blame the servant Leo, who has disappeared. The author himself tries hard not to let suspicion spoil his picture of the servant, and his faithfulness is rewarded. After many years he finds Leo again in a Swiss city, where the servant asks him to follow him to the High Council of the Pilgrims. There he experiences the reward for his faith and belief in his servant. Leo proves to be nothing but the symbol of the author's poetic work, of his call, his destiny. This outcome is a recognition of an artist's task, of anybody's task who has found his way to his real self.

In this book we find a warning by
(Please turn to page 56)

JOB GUARANTEE?



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Hesse concerning intellectual faithfulness. It was the year 1932, and the author was aware of the things that were brewing in many countries of Europe. He was particularly aware of and shocked by the fact that so many leading writers and artists betrayed their own work by doubting it and by escaping to the realm of loud demands. There is a very fine distinction of guilt, however. According to Hesse, if there is misfortune or desertion of a high goal of life, the individual easily searches for the guilt in other people. In *Pilgrims to the Orient* an individual's slightest doubt of his own ideal, his slightest deviation from his own self excludes him automatically from the aristocracy of Orient pilgrims. The guilt lies in the individual himself and any pointing at his neighbor is a new betrayal.

Hesse, therefore, could only portray his own situation. He could not offer stronger warnings. He is not a man of "thou shalt not." All that he does in a situation like that is to fortify himself (in his works or through them) to try to overcome the endangering waves of destruction.

That attitude failed. It was not observed, as so many other warnings of great Europeans at that time were not observed. The masses laughed at Hesse as being schizophrenic; they laughed at Thomas Mann as living in an ivory-tower; and I attended a mass meeting in Breslau and saw people look at Gerhart Hauptmann, who in the last hour had come down from his mountain resort to address a Socialist meeting. They stared at him and felt sorry for "that old man".

Not being heard contributed to the deterioration of Hesse's physical condition. Since 1933 he has been very ill. The effect of that illness is a continuous eye-pain, which makes reading or writing often impossible. During ten years of physical handicap he composed his last great novel, *The Game of Glass Beads* (published in 1943), which greatly contributed to his winning the Nobel prize of 1946.

The center of interest is no longer a person nor a group of people, but, as indicated by the title, the game of glass beads itself. The story takes place in the year of 2400, a date which indicates the author's abandonment of hope that his magic game would find a home and school in our time. But by 2400, he supposes, there will be a group of great men who will devote their entire lives to that precious game. They will settle within the realm of the German language, possibly in Switzerland. A considerable part of the thousand pages is devoted to the description of the game without giving too much detailed and practical information. All nations have contributed to it and its rules, and symbols and grammar represent a kind of highly developed secret language, to which several realms of knowledge and arts have contributed, particularly mathematics and music. The contents and results of almost all sciences and academic disciplines are expressed and placed in relation to one another. "The game of glass beads is a game with all the values of our culture. It plays with them, as perhaps in the classic times of the arts the artists have played with the paints on their palettes."

Josef Knecht, the main figure in this novel, goes through a year-long training for the game. He becomes Master Superior. In spite of his position, he remains polite, controlled, mild, and patient. Suddenly, Josef Knecht's career takes a sharp turn. He, the most admired and most worthy, gradually senses the questionable nature of that spiritual hierarchy, and he leaves it to become a servant in the ordinary world, which does not know much about the great values and conclusions of the glass bead game. He accepts the position of tutor to the stubborn son of his friend Designori.

A great discussion has begun in the world of literature as to Hesse's "real" meaning, particularly since this novel seems to be one of the last into which the author's aged wisdom has filtered during so many years of work. Occasionally the author characterizes Knecht thus: "It would seem wrong

(Please turn to page 58)

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(*Continued from page 56*)

not to mention and not to point out the duality, the polarity in the character and life of Master Knecht, which obviously had not been evident to his surroundings. It should, however, become my task to accept more and more this split in Knecht, or better, this incessantly working polarity in Knecht's soul, as the essential and most characteristic feature of his self and the motif for his decision."

Knecht could not go on as master of the hierarchy since he had, like Siddharta, experienced only the one side of this world, the light, clear one. Devoting oneself to this one only, even in the best of discipleship, will not do. The beads, most delicate as they seem, will break like brittle glass. Only the acceptance and experience of the two worlds will bring the human to happiness. Dedicating oneself to the one of the two will mean stagnation, death. As Hesse says:

Wir sollen heiter Raum um Raum durchschreiten,
An keinem wie an einer Heimat hangen,
Der Weltgeist will nicht fesseln uns und engen,
Er will uns Stuf' um Stufe heben, weiten.
Kaum sind wir heimisch einem Lebenskreise
Und traulich eingewohnt, so droht Erschlaffen,
Nur wer bereit zu Aufbruch ist und Reise,
Mag lahmender Gewohnung sich entraffen.
Es wird vielleicht auch noch die Todesstunde
Uns neuen Raeuman jung entgegensenden,
Des Lebens Ruf an uns wird niemals enden . . .
Wohlan denn, Herz, nimm Abschied und gesunde!

Contributors . . .

(*Continued from page 4*)

Lincoln," an earlier article by Mr. Kubicek, appeared in the December, 1946, issue of the *Illinois Tech Engineer*. He received a bachelor of science degree in architecture at Armour Tech in 1933 and was employed in various positions until 1935 when he joined the Chicago, Milwaukee, and St. Paul railroad. In 1940 he became city passenger agent of the "Milwaukee Road". He was appointed executive secretary of the Alumni Association in 1946 and director of alumni relations in 1947.

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ILLINOIS TECH

Engineer

DECEMBER, 1948

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ELECTRICAL ENGINEER

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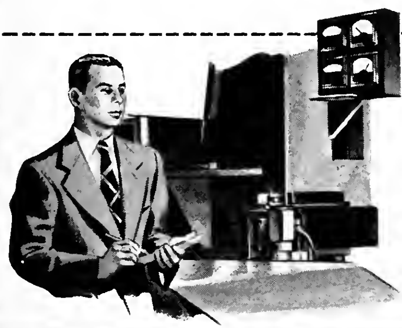

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P. C. Shirkey (Princeton), G-E sales representative with the Republic Steel Corporation: The company needs many men to do the kind of work I'm doing—that is, to keep up with new and increasingly complex apparatus and to find economical and practical applications for it among G-E customers. The company runs its own course for us, in which we study the background of engineering knowledge and experience as well as the theories of sales methods.

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GENERAL ELECTRIC

Contributors . . .

Mrs. Elizabeth A. Simpson is director of the Adult Reading Service of the Institute for Psychological Services at Illinois Institute of Technology. The reading service does both diagnostic and instructional work. Mrs. Simpson directed the reading clinic and taught communication courses at Stephens college, was a clinician in reading at the University of Chicago, and later became a language arts consultant for a publishing house. At present she also serves as a consultant on reading and communications for educational institutions, business and industry. Mrs. Simpson received a bachelor's degree at Macalester college in 1943 and a master's at the University of Chicago in 1944.

Marvin Camras, research engineer at Armour Research Foundation of Illinois Institute of Technology, is the developer of the modern wire recorder. While still an undergraduate at Illinois Tech he spent many hours in his home working with sound recording. His first experiments were with tape, but later he took up an idea forwarded in 1898 by Valdemar Poulsen, a Danish physicist who had recorded sound on steel wire. In 1940 he graduated at Illinois Tech with the highest average in the electrical engineering class and immediately joined the staff of the Foundation where he continued his experiments. His recorder progressed so rapidly that it was declared a full time project and later patents were granted. Mr. Camras' recorder was used extensively during the recent war. The young inventor, whose parents were Russian immigrants, is now only 32 years old.

Harold L. Minkler, assistant director of placement and associate professor of technical drawing at Illinois Institute of Technology, was industrial coordinator for Illinois Tech's *(Please turn to page 4)*

Cover Picture: Winter and snow on the Illinois Tech campus. This sketch is by Charles H. Overly, Lexington, Mass.

VOLUME 14 NUMBER 2 DECEMBER, 1948

ILLINOIS TECH Engineer

IN THIS ISSUE

Published October, December, March and May
Subscription rates, $1.50 per year.
Editorial and Business Office, Illinois Institute of Technology, 3300 Federal St., Chicago 16, Illinois.

(Continued from page 3)

engineering program at Rockford College from its beginning in February, 1946 until July, 1948. He obtained his bachelor's degree at Purdue university in 1940 and his master's degree at Texas A. & M. in 1941. Before joining the Illinois Tech staff in 1941, he served in the navy as an officer in Hawaii, Australia, New Guinea and the Philippines.

Frederick W. Jauch is assistant director of public relations and director of athletic publicity. A biographical sketch of Mr. Jauch appeared in the October issue of this magazine.

Daniel P. Barnard IV, research coordinator for the Standard Oil Company of Indiana, received his master's and doctor's degrees at Massachusetts Institute of Technology after completing undergraduate work at the University of Delaware. Before joining Standard Oil in 1925 as assistant director of research, Dr. Barnard served for three years in the research laboratory of applied chemistry at M.I.T. He is president of the Co-ordinating Research Council, chairman of the automotive-research committee of the American Petroleum Institute division of refining, and a member of the National Advisory Committee for Aeronautics.

Pearce Davis, professor and chairman of the department of business and economics at Illinois Institute of Technology, was a faculty member in the department of economics at Harvard University before his appointment at Illinois Tech in 1946. Dr. Davis' educational background includes a B.S. at the University of Pennsylvania, an A.M. at George Washington University, and a Ph. D. at Harvard University. In the field of labor Dr. Davis has held positions as principal economist of the New York Regional War Labor Board; assistant director of National Wage Stabilization; chairman of the National Telephone Commission; chairman of the New England Wage Stabilization Board; and co-chairman of the National Meat Packing Commission. Last March he was one of three members of the board of inquiry appointed by President Truman to study the meat packing strike.

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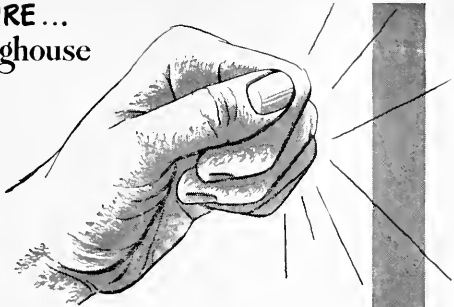

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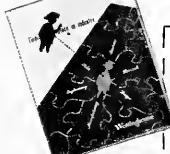

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You Can Read Faster — And Learn More

by ELIZABETH A. SIMPSON*

MOST adults waste a large portion of time when they read.

This doesn't necessarily imply that you spend time reading trivial materials, but rather it means that you could read, at the very least, twice the amount of material you are reading at present. There is a tremendous growth in the number of materials you are asked to read, but your reading rate may remain unchanged if you do nothing to improve it.

During the past decade there has been a tremendous increase in interest in adult reading. This interest has resulted from a realization of the fact that adults can read much more efficiently than they do. The little known facts about adult reading abilities are astonishing. Statistics show that in the Chicago area 60 per cent of the adults are not reading beyond the eighth-grade level; a proportionately large number are not reading even as well as the eighth-grade level. Surveys show that throughout the nation few adults read with better than sixth to seventh-grade efficiency, and most are reading no faster than 150-253 words per minute. Few college graduates read any faster than 350-450 words per minute. It is easily seen from these statistics that *communication* through the process of reading is not as easy as many people think; it is obvious that a large part of the population may be expected to have some reading difficulty.

A Newer Concept

With the increased interest in adult reading a new point of view has resulted. The older viewpoint assumed that adults were good readers because they had learned how to read in the grammar schools. The newer concept of instruction in reading is much broader and recognizes the fact that no matter how well you read, even at the adult level, you can learn to read better. This concept recognizes that adults need training in reading, which will facilitate more extensive reading with more rapid comprehension. For adults the *speed* factor is a highly important one. As a result of this newer concept, more than three hundred colleges and universities now provide some type of reading training through a reading clinic or service. The number of places offering reading training to adults no longer in college is still extremely limited because of lack of funds and trained personnel. In reading services, reading is taught directly, and one's ability to understand can be significantly improved in a training period that is not time consuming. For example, the reading of officers in the Air University, Maxwell Air Force Base, Montgomery, Alabama, was speeded up by special training from an average of 250 words per minute to approximately 600 words per minute with no loss in comprehension. It is perfectly correct that you, too, may assume that you can read faster.

It is not difficult to realize what it would mean to *double* your rate and comprehension. If you do not read faster than 250 words per minute, you have two alternatives—either to spend practically all of your time reading, or to limit what you read. The first alternative may deprive you of the necessary time for your business, personal, and social responsibilities. The second alternative imposes an even more serious problem—that of precluding the possibility of learning new facts and acquiring increased knowledge through extensive reading. I am reminded at this point of an engineer who said he had been trying for several months to read something interesting besides materials relating to engineering. The two books he selected were Toynbee's *Study of History* and *The Kinsey Report.* In words of his own he said, "I get so bogged down with mountains of paper work at the office, that I always carry a brief case full of papers home at night, and, if I finish that reading, I never seem to be able to read more than one page of either book each night. What's more, I have been reading no more than one page of any book a night since I was in college." These exact words of an engineer are typical of the feelings expressed by most adults about their reading.

The Reading Process

It is not true that the slow reader is the careful reader, nor is it true that the fast reader is the careless reader. Invariably, the rapid reader scores higher on his comprehension of the materials read than the slow reader. One of the basic difficulties of slow or word-by-word reading is inward *vocalization,* which may be a "hang-over" from early training in word recognition and oral reading. It is almost certain that anyone who reads 250 words per minute or less is a victim of verbalization in his silent reading. This verbalization may occur at three increasingly subtle levels: (1) lip movement, (2) throat movement, (3) internal auditory perception.

When you read, you pause, and each pause is called a *fixation.* If you permit your eye to make a return sweep and read what you have already read before, you have performed a special type of fixation known as a *regression.* Regressions not only slow down your speed of reading, but impair your comprehension as well. When your eye fixates, you perceive material which the brain then proceeds to translate and give meaning. During the

*Director of the Adult Reading Service of the Institute for Psychological Services at Illinois Institute of Technology.

Figure 1

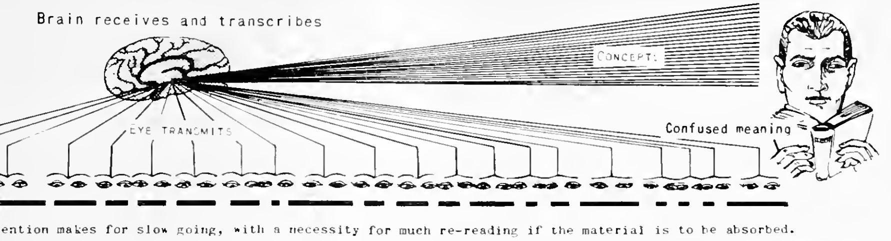


Figure 2

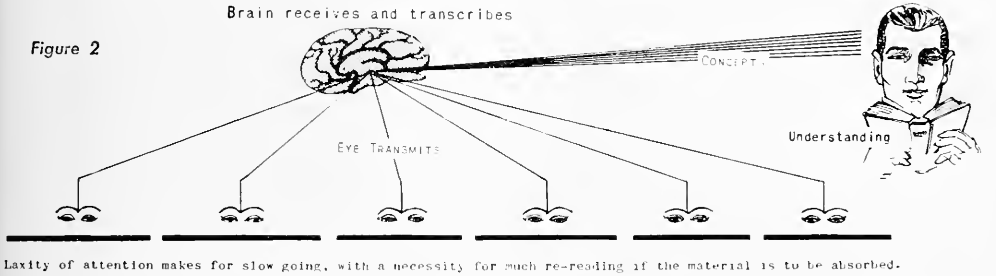
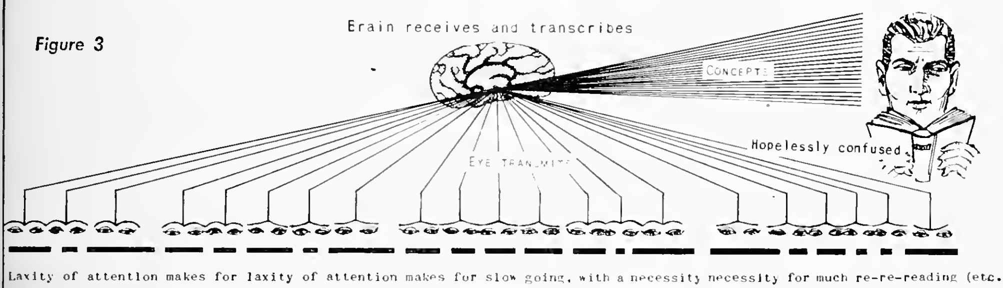


Figure 3



movement of the eye between fixations no material is seen. Imagine you are reading the following sentence:

"Laxity of attention makes for slow going, with a necessity for much re-reading if the material is to be absorbed."

If you are a slow reader and look at each word in this sentence and do not regress, you will have 21 fixations. When your eye arrives at the period, the brain has to piece together the meanings or concepts of 21 separate words—an almost insurmountable task. (See Figure 1.) On the other hand, if you are a fast reader, you will read this sentence with only six or seven fixations instead of 21. With only six or seven fixations your eyes see more with each fixation and larger translations are made by the brain; consequently, you comprehend more accurately at a faster rate. (See Figure 2.)

If you had read by words, and regressed, your reading might have taken this form:

"Laxity of attention makes for laxity of attention makes for slow going, with a necessity necessity for much re-reading if the material the material is to be absorbed."

In this case the number of fixations has increased considerably, and difficulty of comprehension has become enormous. In addition, the pleasure of reading has completely disappeared! (See Figure 3.)

Some people have as many fixations as there are words per line: others may have only one or two fixations per line of print. Those who read a line of print with only one or two fixations are not only more rapid comprehenders, but they find reading a more relaxing and pleasant experience.

The development of a wide recognition span, hence, fewer fixations per line, is blocked by words for which you do not know the meaning or by lack of concentration. Enriching your vocabulary and alleviating the causes for lack of concentration will pave the way for an increased span of perception and make training on this skill more effective.

Diagnosing Reading Skills

The diagnosis of reading skills is a job for a specialist. A good diagnosis in reading includes measures of four factors: (1) *mental capacity,* (2) *visual capacity,* (3) *reading skills,* (4) *personality.* To obtain a true rating of your mental capacity, an intelligence test should be used that does not place you at a disadvantage because you have a reading problem.

Learning how to improve comprehension by 1) reading for the main idea, 2) reading for the right detail, 3) reading to understand the author's purpose.

Many of our so-called intelligence tests today are also reading tests because you are asked to read in order to answer the questions. The person who does not read as well as he might certainly is handicapped in demonstrating his true mental capacity. It is not at all uncommon to find an adult with an I.Q. of 118 who reads at only the sixth-grade level. This kind of person never makes a good showing on a paper and pencil intelligence test. For adults, the Wechsler-Bellevue intelligence test, which does not call for the use of reading skills and which is primarily a measure of power rather than speed, will provide necessary information of the extent of your intellectual capacity.

A check of your visual pattern is necessary to determine whether or not you have visual problems of a nature that will impair reading improvement. Three instruments are available for checking visual skills: (1) *ortho-rater*, (2) *sight-screener*, and (3) *telebinocular*. The results of checks made on these instruments are used as a basis for determining whether or not it is necessary to see an eye specialist before reading instruction can be started.

No one reading test provides a diagnosis in itself. Therefore, it is absolutely necessary for the more effective measurement of reading skills to administer a variety of reading tests. Through paper and pencil and oral reading tests, the level of each reading skill is determined. These tests cover *word recognition, word meanings, comprehension*, and *rate*, each of which can be further sub-divided into its component parts. The eye-movement record is taken with the *ophthalmograph* which photographs the movements of the eyes as they read the printed page. The photographic record shows you how your eyes actually perform while you are reading.

Due to the frequency with which personality and reading problems overlap, it is necessary to administer a good personality inventory. Frequently it is extremely difficult to say whether the reading problem is the cause of the personality problem, or if, conversely, the personality problem is the cause of the reading difficulty. A strong feeling of insecurity, for example, may actually impose a block between the printed page and your ability to comprehend what you are reading; or you may be such an inefficient reader that extreme feelings of insecurity are the end result.

After a thorough diagnosis, your results need to be analyzed by a trained person, who then should interpret these results to you. Your improvement in reading will be effective only if you fully understand and are

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An individual measure of mental alertness.

Magnetic Records for Home Entertainment

by MARVIN CAMRAS*

IN the last few years, people who learn that we work with magnetic recording have invariably asked us, "When will magnetic recorders replace the phonograph?".

The answer is, of course, that one is not a direct substitute for the other. In fact, at present there is no real competition between the two because they serve different purposes. The convenience, flexibility, and widespread use of disc phonograph records is hard to equal, especially for popular music. However, there are other kinds of home entertainment which are best fulfilled by magnetic recording.

Most magnetic recorders available to the public today, are designed for "home recording". They are used to record programs off the air, for parties, for voice training, for talking letters, etc. In this field the magnetic recorder is ideal. We can get a full hour of recording on a single spool which takes up little storage space. The material can be erased and reused, or edited and spliced. The records do not wear out or deteriorate rapidly. Cost of the equipment is low and it requires a minimum of technical skill to operate.

In spite of all these advantages, the magnetic recorder cannot substitute for the phonograph until pre-recorded entertainment is available for over-the-counter sale. What problems must be solved before we have a magnetic record library? Admittedly there are technical difficulties, but it is possible to manufacture large quantities of magnetic records quickly and at low cost.

One problem in the past has been a potential market for record libraries. It does not pay to set up for record production unless a large number of copies can be sold. This requires first of all, that the machines be in the hands of the public. On the other hand, it has been said that if attractive pre-recorded material were available, the public would buy more machines. Fortunately, pre-recorded music is not necessary to start the cycle, because magnetic recorders can make their own records.

Standardization of tape and wire speeds and interchangeability of spools and reels is quite necessary. In this respect the RMA and other committees have done an excellent job.

Another problem is the cost of the record material. Disc records cost roughly ten cents per minute; that includes artists' royalties, etc. Retail prices of unrecorded wires and tape are about half this price, so it ought to be possible to record on such material and sell at a profit.

Magnetic records on tapes and wires are best adapted for long playing times. This is an advantage for classical and high quality musical works, because the entire selection can be played through without a break. Several other factors also favor magnetic recording. There is no deterioration

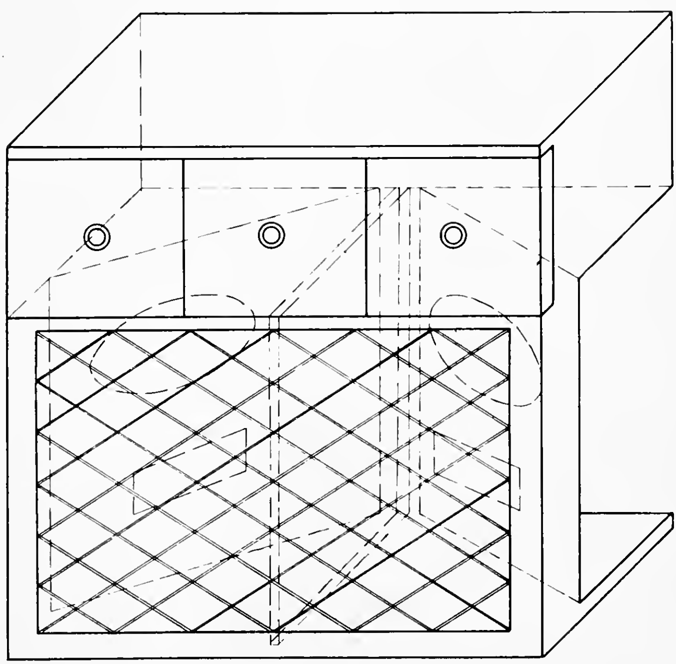

Figure 1. A home stereophonic unit.

*Research engineer at Armour Research Foundation of Illinois Institute of Technology and developer of the modern wire recorder.

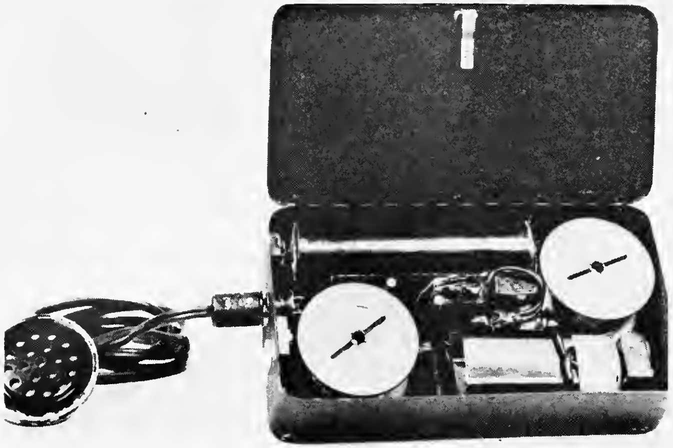

Figure 2. A pocket model recorder.

in quality such as that which occurs when playing the inner grooves of a disc record; the frequency response is excellent; the distortion is low. But more than any other single factor is the low background noise; it is practically inaudible even on a wide range playback system. This is due in part to the character of the noise, which is steady and smoothly distributed over the audible spectrum. In contrast, a vinylite disc may give sharp clicks that are quite noticeable to the ear, even though a meter indication shows the integrated noise to be very low.

Stereophonic Music

Recent developments in stereophonic recording promise to provide home entertainment that is different and more satisfying than anything that has been available before. Not only orchestras, but also operas, plays, and dramatic presentations are made to appear as if they were on a stage in front of the listener. Location of instrument and movement of actors is easily discernible. In the stereophonic system a recording is divided between two channels on a tape, each channel taking care of one side of the room. A dihedral projection system allows the entire system to be built into a single cabinet. Figure 1 shows a proposed stereophonic home unit.

Stereophonic tapes should be no more expensive to make than standard records, and it may be that all high quality records will be released stereophonically. If this were done, it would still be possible to play such records on single-channel home machines. One of the channels could be played alone, or the two could be mixed in any desired combination, either electrically or mechanically. The mixer control would allow new effects that were never before possible for the radio or phonograph listener, because it would permit adjustment of the balance of an orchestra as well as the frequency response. Ordinarily one channel represents the left side and the other the right side of an orchestra, but the effects could be varied; for example, one channel might be a close "dead" recording, and the other a distant pickup with a high percentage of reverberation. The home listener could mix the two in any proportion to suit his taste.

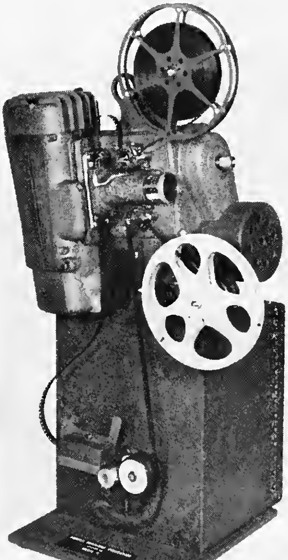

Figure 3. An eight mm. magnetic sound projector.

Reprocessed Records

It is conceivable that, to reduce the cost of home entertainment, a rental service could be established on much the same basis as film rental libraries. One difficulty might be the inspection of returned records to make sure they were intact. This is quite feasible in film rental libraries where costs of the initial film and rental fees are relatively high; but it might not work as well for the lower cost magnetic records.

A proposal that appears very suitable would have the customer buy a number of blank rolls of record material and pay for having records put on them. Old records which were no longer needed could be erased and re-recorded. Thus a person would not need to have many "dead" reels in his collection, but could have them re-recorded with current favorites.

The reels could be sent to a central headquarters for re-recording either on a mail order basis or by leaving them at the local music shop which would send them out wholesale; or the music dealer himself could own a reprocessing machine, and he would buy or rent master records from a recording company.

Another possibility that appears very attractive would be to set up coin-in-the-slot vending machines. The customer loads his reel into the machine, deposits a coin, and a short time later receives his reel with the latest song hits recorded on it. If this type of recording comes into fashion, a record shop may look like a Horn and Hardart Automat, with the main duty of the clerks to provide change.

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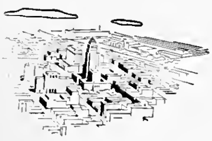

A Community Mobilizes for Engineering Education

by HAROLD L. MINKLER*

IN 1945 Rockford, Illinois, was a thriving industrial center with a metropolitan area population of over 115,000 that was served by four railroads and was very proud of its two new senior high schools, three junior high schools, and 19 grade schools: it boasted further of nine parochial schools and Rockford College for Women.

This college, located in the heart of the city, is one of the oldest colleges for women in the United States. It offers a four-year program in the liberal arts.

Rockford is regarded as Illinois' second industrial city. Here 293 industries produce between five and six-thousand separate items. This tremendous industrial center was, in 1945, lacking the facilities to train men for the higher bracket industrial positions. The closest engineering colleges were located at the University of Wisconsin, 50 miles to the north; Northwestern Technological Institute, 90 miles east; and Illinois Institute of Technology, 90 miles east.

Young men from Rockford attended these three schools as well as the University of Illinois; however, once they left Rockford, they didn't seem to return, except for an occasional visit. How Rockford industries became aware of this alarming situation is reflected in the history of the inception of the Rockford College—Illinois Institute of Technology Cooperative Engineering Program.

Mr. Minkler (left) looks over the drawing of an Illinois Tech engineering student at Rockford. (Picture by courtesy of Rockford Consolidated Newspapers, Incorporated.)

Immediately following World War II, 138 Rockford industries contributed a minimum of $10 for every man who left his employment to join the armed services. This money totaling $36,000 was used to organize "Rockford Plans Inc.", an organization devoted to giving advice or vocational guidance to 57 per cent of Rockford's returning veterans. Eighty-two per cent of the veterans who took vocational guidance tests were placed in appropriate positions in industry. It is interesting to note that in a survey conducted 18 months later, it was found that only 1.6 percent of these men had changed jobs. This record has not been equalled anywhere in the United States according to the Psychological Corporation. A number of the veterans counseled were advised to continue their education, but Rockford had nothing to offer. The expense of going away to college was more than most veterans could afford, even with the assistance of the G I Bill.

One of the duties of Rockford Plans was to determine the veterans' needs and a means to alleviate the needs. The educational committee was informed of the startling facts concerning the critical shortage of young college trained engineers in Rockford's industries. Results of the tests which were

*Assistant director of placement and associate professor of technical drawing at Illinois Institute of Technology; formerly industrial coordinator for Illinois Tech's engineering program at Rockford College.

Navy veteran John Langehr, his wife, and son admire the garden produce canned by Mrs. Langehr while her husband, although lacking a high school education, achieves a brilliant record as a student in the Rockford College engineering program. (Picture by courtesy of Rockford Consolidated Newspapers, Incorporated.)

previously mentioned had shown that college material was available and the city's engineers had shown the definite need. Here was a supply and a demand. However, there was no way to bring the two together. It was quite evident that something had to be done immediately; therefore on November 27. 1945. it was decided to invite Dr. Mary Ashby Cheek, president of Rockford College. Dr. Henry T. Heald, president of Illinois Tech, and Dr. Robert Browne, director of the extension division of the University of Illinois, to attend a joint meeting in Rockford on December 18, 1945.

This meeting was held with Dean J. C. Peebles substituting for President Heald. Eight of Rockford's largest firms were represented. All are well known to the industrial world—Barber-Colman, W. F. & John Barnes, Greenlee Bros, Ingersoll Milling Machine Co., George D. Roper Corp, Sundstrand Machine Tool Co., Woodward Governor Co., and Smith Oil Refining Co.

During this meeting, a representative engineer cited the needs of industry and the president of Rockford College gave a general discourse on the part that the college could and would play if some plans could be made.

Dean Peebles told of the practical aspects and the problems that would arise in setting up a workable engineering program. He suggested that a cooperative engineering training program be considered and, if approved, that a coordinator be hired.

Here was an ideal situation—almost 300 industrial plants, eligible prospective engineering students, college facilities, and strong support from industry, strong support to the extent that the industry agreed to underwrite the coordinator's salary for a period of one year!

Dean Peebles was asked to select candidates for the position of coordinator. On the night of February 6, 1946, I was interviewed and hired as coordinator. On February 7. plans were underway to start school at the earliest possible date, preferably by September, 1946.

The problems of the coordinator were far different than those of coordinators in other schools. Here an engineering school for men had to be organized in the midst of the trials, tribulations and traditions of a women's college about to celebrate its centennial. Like all colleges, Rockford College had reached the enrollment saturation point; however, there was always room for just one more class!

Before class schedules could be given any consideration, office space for the coordinator had to be found. Then another serious problem arose — that of finding facilities for men in a women's college! The girls on the campus were very cooperative and offered to relenquish one of their recreation rooms to the men. It also became necessary to break another precedent by allowing men to eat on the campus. These may seem like trivial matters, but remember, we were breaking 100-year-old traditions.

A two year curriculum in mechanical engineering was planned according to the IIT bulletin and the instructors that were available on the Rockford College campus. Brochures had to be printed explaining the proposed cooperative engineering program.

All plans for teaching and handling students were completed, and the next problem was that of selecting students. Enthusiasm among the industries was so great that it was decided to organize a class that would start its academic work on April 22, 1946. This date preceded the original starting date by five months. The brochures were mailed to every industry in the city, but the student enthusiasm was not as great as that of the industries. It did not take long to determine the cause for the lack of this enthusiasm.

Young men enrolled in the Illinois Tech program at Rockford do not confine their activities entirely to technical subjects. The students above were helping to prepare for the opening of a speech class with Dr. Jeanette Anderson (right), director of the college's speech clinic, when this picture was taken. (Picture by courtesy of Rockford Consolidated Newspapers, Incorporated.)

One sentence in the brochure read, "It is requested that all prospective students take and pass the standard entrance examination given by Illinois Institute of Technology." It then became necessary to assure all parties concerned that the entrance examination was merely an aptitude test and was used to separate students with engineering aptitude from those with other bents. Most of our applicants were selected by the company, sent to the coordinator for an interview, and given an application blank if the proper prerequisites had been fulfilled. In many cases arrangements were made to administer the tests at the company on company time. Approximately 50 per cent of the students applying for admission to the first class were accepted. On the morning of April 22, 1946, 22 students had been accepted into the program, and by evening they had started their college careers.

Our problem with the Veterans Administration were many. All but one in that first class were veterans. The Rockford College officials had informed me that the college was approved by the VA; however, it was soon found that contracts for PL 16 students, bookstore procedure, etc. had not been necessary for female students. It was now apparent that the coordinator had to assume the duties of a veterans counselor.

Veterans Administration procedure is now handled very effectively and efficiently. Last spring 101 students were enrolled in school with 23 cooperating firms. Ninety per cent of these men attending school were under the G I Bill. Fortunately in a cooperative program such as this, the school knows months in advance the students who will be interrupting at the end of the term and the students who will be reentering at the beginning of the next term. All forms are sent to the VA 30 days in advance of the anticipated action. In this way, the forms are handled one month prior to the peak-load at the VA. This alleviates overpayments or undue delay in receiving subsistence for the student.

A small college such as this has the opportunity to give a full-time summer school program. Our summer semester was divided into two seven-week periods during which we taught on a concentrated basis. In this way, a student could enroll for four or five courses during the summer. Faculty teaching schedules were easily arranged for many teachers who vacation in June and July and do not object to working during the months of August

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From left to right are: Mr. Minkler, Don Howell, John J. Schommer, and Ray Carlson. Schommer, Illinois Tech athletic director and director of placement, helped plan the sports program at Rockford. Howell and Carlson were both members of the Rockford Techawks basketball team. (Picture by courtesy of Rockford Consolidated Newspapers, Incorporated.)

SPORTS AND ILLINOIS TECH

(This is the second of two articles on the athletic program at Illinois Tech. The first article, which appeared in the October issue, described the present program and outlined future prospects. Intercollegiate athletics were defended and declared to be, in general, beneficial to a college with the objectives of Illinois Tech and to the nation as a whole. The Institute's administration, it was explained, desires as strong an intercollegiate program as possible, but that program must always stay within the ideals of the college. The present article pictures and discusses some of the evils of intercollegiate sports, considers the question of intercollegiate football at Illinois Tech, and offers a few general suggestions that may help the Institute produce those stronger athletic teams within its ideals.)

The Darker Side

Several winters ago one of the smaller colleges in the midwest was anticipating the most triumphant basketball season in its history. Largely responsible for the bright outlook was a very outstanding young athlete who was fast, agile, and clever, and who could drop a ball through a basket from almost any angle with almost any type of shot. He was the conversation of the campus; he was his coach's fondest dream come true.

All was well and happy, until a startling rumor reached the coach two days before the opening game. His star, the report said, had been playing basketball for a second school. He was being flown, the rumor went, to the second school some 250 to 300 miles away. There he turned in his 40 minutes of basketball, was paid a neat sum, and was returned immediately by air. The story seemed unbelievable. But the coach and the athletic director checked and they discovered that it was true.

The athletic director wired the president of the second college. Was this athlete, he asked, enrolled in the second college?

The answer said that he was.

The athletic director wired again: In what courses was he enrolled?

The reply listed a scholastic program.

A third telegram went out: Has he been attending classes?

by FREDERICK W. JAUCH*

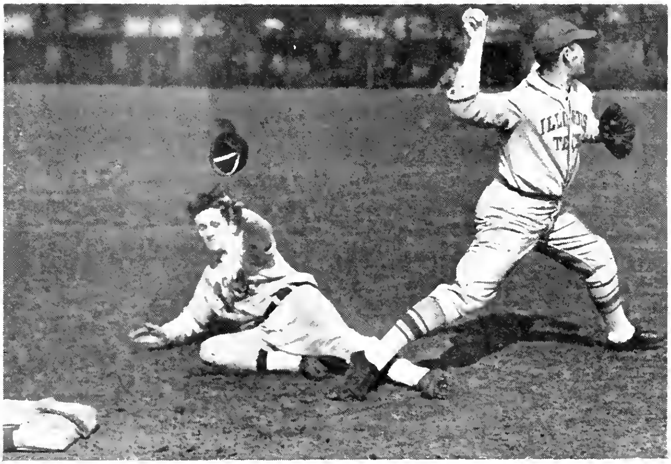
*Assistant director of public relations and director of athletic publicity at Illinois Institute of Technology.

This time there was no answer.

The athlete was promptly dropped from the squad; but, while still a student at the first school, he continued to play at the second college. In fact, he played again last year — after he had graduated at the first school—and received nationwide publicity for his basketball accomplishments. He is expected to be in uniform again this winter. Indeed, the second college never bothered in the first place to play him under an assumed name.

There is another extremely basketball-minded institution in the midwest who last winter listed every man on its basketball roster as a sophomore, except for three or four who went down as freshmen. Going through the roster, the perplexed fan seemed to recall that most of these "sophomores" had been playing basketball for this school or another for two or three years. If not ethical, it was probably all legal, however; some of these boys had played part of the time as navy or marine trainees. Participation while a member of the armed services did not count against one's eligibility in most collegiate conferences, but the organized conference's had been able to check exploitation of the resultant confusion. This particular college, not a member of any conference, was, however, making the most of it.

Take the case of one young man who was listed as a "sophomore". He had spent three years as a naval trainee and star basketball forward at a smaller college in the vicinity during the war. Before the war he had played for one year as a civilian at still a third school. But now he was lost in the shuffle of all these other brilliant "sophomores". He decided that he had had enough of a college education. One afternoon he quit the squad and the following morning he walked into the appropriate administrative office, presented his credits from the two previous schools, and at the end of the semester received his diploma.



A Techawk infielder pivots and throws to complete a double play in a contest lost spring with Chicago Teachers. The baseball team plays its home games on the Armour Square diamond.

An outstanding football lineman has received a bit of attention by the press recently for one remarkable record that he has established—the fellow this fall completed his eighth year of intercollegiate football. He performed for three years before the war at a southern university, for another year while a navy trainee at a second southern school, for three years at West Point, and this past autumn for one more season at his original southern alma mater. One hopes that he, too, will manage to pick up a degree eventually.

The basketball Techawks opened the 1948-49 schedule in November with hopes of one of the best seasons in years. In the picture above are Coach Ed Glancy and six of his returning lettermen.

These are, of course, just a few random cases and they are by no means the most flagrant violations of the amateur code that might be cited. Any one with his eyes half-open knows what's going on in intercollegiate athletics today, and what has gone on since the first World War. The thorough scouting systems employed by colleges, the free rides, the monetary rewards sometimes far above the necessary school and living expenses, the ridiculously easy scholastic programs for some athletes—all of this is old stuff. The southern schools are undoubtedly the most professional in their approach to intercollegiate athletics, but many people are inclined

to admire this open policy more than that of many of the northern, eastern, and western schools and conferences who, while somewhat more respectful of the code, continue to profess complete purity.

One usually thinks of intercollegiate football when the evils of college athletics come up for discussion. But college basketball is rapidly catching up to the colorful autumn sport. Here the smaller schools are the worst offenders. Unable to afford football teams, or, at least, good football teams, they emphasize basketball. Because basketball is followed less, publicized less, and probed less, the college will get away with more. Because, usually, they are not under the control of a conference, lax as that control might happen to be, they have only their consciences to guide them. Some of these schools have shown no evidence of a conscience at all.

It would be unfair, I think, to continue without a qualifying remark or two at this point. The college athletic situation, while not as white as some of our athletic leaders would wish us to believe, is at the same time not nearly as black as some of its critics have pictured it. Not all nor even most of today's athletes are tramps; not all nor even most of today's coaches are shrewd, underhanded "dealers". Phi Beta Kappa athletes such as Byron "Whizzer" White and the late Nile Kinnick are news because there are not many of them; but where, except among college professors, are Phi Beta Kappas much more commonplace? A good, perhaps surprising percentage of Saturday's gladiators are quite admirable young men of average or above-average intelligence who carry heavy scholastic programs, study hard, and come out with a college education for their four years. Some of their less admirable colleagues undoubtedly make a more lasting impression upon the public, which, of course, tends to lump them all into one category.

Michigan for the past several years has claimed that the scholastic average of its football squads was well above that of the student body as a whole. One can believe this after watching the magic, the precision, the delicate timing and intricate maneuvering of the 1947 national co-champs and Rose Bowl winners. There was no place for the celebrated football blockhead in that organization. Michigan also claimed that every member of that championship team was strictly an amateur; one can disbelieve or believe that statement, as he is so inclined. The famous Whiz Kids of Illinois, who before the war formed what was probably the greatest college basketball team of all time, were a group of thoroughly likable, serious, quiet young men who completely lacked any of the alleged typical "trampian" qualities of the college athletic star.

These are just two favorable examples provided by a couple of the more outstanding college athletic teams of the past decade. There are some fine people playing, coaching, and directing in intercollegiate athletics; there are ideals that still live in college sports. I think that each of us who wants a whole, true picture of the situation must remember that.

Who's to Blame?

But who's to blame for the over-commercialization, the sophistry, and the malpractice?

Is it the athlete? In most cases only in a very minor, indirect way. He did not create the situation, of course. The situation is there for him, and not many people, I believe, would refuse to take some advantage of it; especially when the person sees no harm in it. And the harm is not apparent unless one takes a sociological or philosophic view, something that most high school seniors are not likely to be doing. (It is granted, however, that one should be able to expect more from our youth than the performance of the boy who attended one school and played for another.)

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Roy McCauley, track coach, gathers his squad for a discussion of times and distances. Illinois Tech track prospects, like those in almost all the sports at the Institute, are much brighter this year than last.

ELEVENTH ANNUAL

MIDWEST POWER CONFERENCE

APRIL 18, 19, 20, 1949

The eleventh annual meeting of the Midwest Power Conference will be held at the Sherman Hotel, Clark and Randolph streets, Chicago, on April 18, 19, and 20, 1949. The principal sessions of this year's conference will be centered around the theme, "How to better supply our power needs during a period of declining resources".

The Midwest Power Conference is sponsored by Illinois Institute of Technology in cooperation with nine midwestern universities and nine professional societies: Iowa State College, Michigan State College, Northwestern University, Purdue University, State University of Iowa, University of Illinois, University of Michigan, University of Minnesota, University of Wisconsin, the local sections of AIChE, AIEE, AIME, ASME, ASCE, ASHVE, the Western Society of Engineers, the Engineers' Society of Milwaukee, and the National Association of Power Engineers.

Largely through the efforts of these institutions, the conference has grown rapidly and is now the largest of its kind in the world, attracting each year some 2,500 to 3,000 leading engineers from all parts of the United States and Canada.

Recognizing its responsibility to industry, the conference recently established a committee of industrial leaders, interested in power, to serve in an advisory capacity and to aid the directorate in planning a program which will be of greatest benefit to those who attend the conference.

Serving on this committee at the present time are D. A. Sullivan, chairman, Commonwealth Edison company; H. H. Chapman, Westinghouse Electric company; J. C. Collier, Allis-Chalmers Manufacturing company; P. B. Garrett, Electric Light and Power; R. T. Hanlon, National Aluminate corporation; Fred C. Hensel, Combustion Engineering company; A. H. Kuhn, Pioneer Service and Engineering company; Vernon Leach, Peabody Coal company; J. C. Meier, McGraw-Hill Publishing company; B. F. Pfandhoefer, General Electric company; R. L. Swinney, Babcock and Wilcox company; H. V. Van Valkenburg, Anaconda Wire and Cable company; and Edwin Vennard, Middle West Service company.

The preliminary program for the 1949 meeting is now being formulated by R. A. Budenholzer of Illinois Tech, conference director. Working with him are Edwin R. Whitehead also of Illinois Tech, conference secretary, and the following members of the staff of Illinois Institute of Technology and its Armour Research Foundation: Professors F. D. Carvin, William Goodman, W. P. Green, W. A. Lewis, K. W. Miller, J. T. Rettaliata, E. H. Schulz, and S. E. Winston.

Some 24 sessions, each consisting of two or more papers, are being planned in addition to the joint luncheons with ASME, AIEE, and the WSE. These include sessions on both large and small power plants, feedwater treatment, Diesel power, hydro power, central station practice, atomic power, heating and air conditioning, control systems, the heat pump, gas turbines, and electrical distributing systems. As in the past, the main event will be the All-Engineers Dinner.

The preliminary program will be ready for distribution early in February and will be printed in full in the March issue of this magazine.

All who are interested in the field of power and in the problems facing the nation's power engineers are cordially invited to attend the conference. Place the date on your calendar and make reservations at your favorite Chicago hotel as soon as possible.

All inquiries with respect to the conference may be addressed to Edwin R. Whitehead, Conference Secretary, c/o Illinois Institute of Technology, Chicago 16, Illinois.

Why Not Higher Octanes?

by DANIEL P. BARNARD*

MAN'S desires have no limits. The average person may not be able to imagine new products for his use, but he enjoys the aids, comforts, amusements, and gadgets conjured up by those who do have the necessary ingenuity. While it may not be generally appreciated, our national economy rests largely on these desires for new and improved articles.

Transportation is probably the outstanding difference between the American way of life and the lower standards of the rest of the world. Even in highly-developed England the automobile has almost no place in the worker's daily life. There it is either a business vehicle or a luxury for a few highly-privileged individuals. The United States, however, is a nation on wheels. During the past half-century our cities and our rural districts have both become dependent upon automobiles, trucks and buses.

During the war, imaginative artists pictured post-war wonder automobiles and airplanes. There were hints of 100-octane number gasoline at every filling station. As we look back upon these startling predictions, we naturally wonder what happened to them. More important, what is actually likely to transpire in the near future? This short discussion will have to bypass the automobiles and airplanes of the future and limit itself to the question of gasoline. What about those predictions of 100-octane at every service station?

Any such discussion of gasoline must recognize the other so-called light distillate fuels — kerosene, heating oil, tractor fuel, furnace oil, and diesel fuels. These products are made from the same crude and are intimately related. Their principal components come from the same process equip-

*Research co-ordinator for the Standard Oil Company of Indiana.

ment and it is possible to make additional gasoline at the expense of the other products in any modern refinery.

The light distillate fuels (gasoline, kerosene, furnace oil, etc.) comprise some 60 per cent or more of the total products ordinarily produced from average crude. Residual products—lubricants, heavy fuels, asphalts, etc., account for less than one-third of the output. Process fuels and losses take care of the rest. Prior to World War II, the nation's maximum crude production of about 3,700,000 barrels per day plus 100,000 barrels per day of natural gasoline gave us about 2,300,000 barrels of refined distillate products. Neither producing nor refining activities were overworked. Actually, refining capacities were at least 15 per cent greater than the demand. During the war, it became necessary to push up outputs in order to make military products, notably 100-octane aviation gasoline. By the end of the war we were producing 500,000 barrels per day of 100-octane and about 1,600,000 barrels per day of motor gasoline. The production of all distillate fuels was over three million barrels per day from slightly less than five million barrels per day of crude plus natural gasoline. This was a real achievement, particularly when one considers that 100-octane aviation gasoline contains a large percentage of synthetic products for which most of the manufacturing facilities had to be built after the war began. Also, making this high-octane material entailed considerable sacrifice in the production of motor gasoline.

It was only natural to believe that the end of the war would relieve this burden on the refining industry. However, instead of the expected drop, the industry found itself faced with demands nearly 15 per cent *over* the highest wartime level. The result has been a nip-and-tuck struggle to meet the public's wants.

Just prior to the war, kerosene and other heating oils totaled some 700,000 barrels per day. This demand rose to 900,000 barrels in 1945. The expected demands for the winter of 1948-49 are expected to bring the year's average to nearly 1,400,000 barrels. The demand rose so rapidly that in 1947 it was physically impossible for the petroleum industry to supply fuel for any further increases. The manufacturers of heating equipment therefore drastically curtailed their activities.

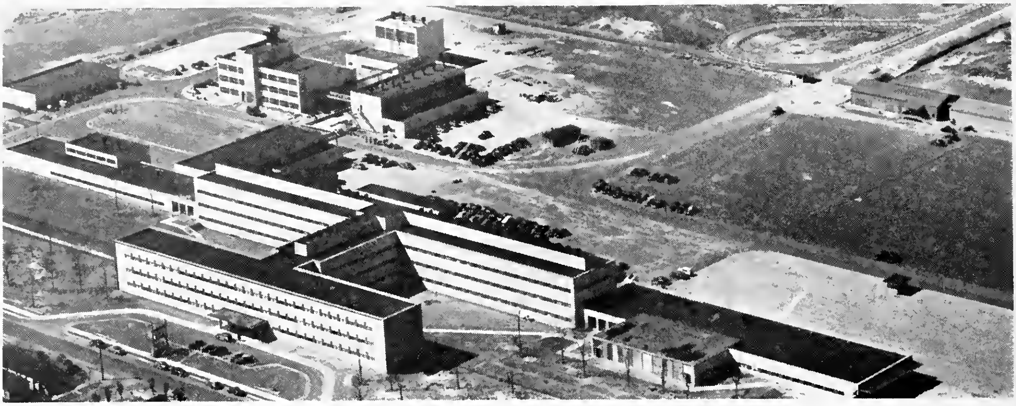
This demand increase resulted in occasional local shortages of motor gasoline and in non-materialization of the fantastic wartime prognostications for postwar octane numbers. As was indicated earlier, the production of 100-octane aviation gasoline during the war necessitated the loss of considerable quantities of motor gasoline. No known refining method achieves octane-number improvement without some sacrifice in the amount of gasoline from a given quantity of crude. Prime consideration must be given to producing the necessary volume of gasoline for the cars actually on the road. High octane-number postwar gasoline must wait until it can be justified by the ability of cars on the road to make proper use of it. This situation is given added emphasis by the fact that the number of cars and trucks of prewar type in use actually has increased steadily since the war. A total of 40,000,000 vehicles are now on the road, compared with around 36,000,000 just before the war—an increase of more than 10 per cent. Since there is in addition an increase in the use of many of these cars and trucks, the big jump in gasoline demand is hardly surprising.

Back in the mid-1930's, the petroleum industry produced and refined about 2,700,000 barrels of crude oil per day but could have produced and refined much more. Competition for business was therefore intense. At that time each marketer sought any possible quality feature that might help him wrest business from his competitor. With this background, the predictions for postwar 100-octane motor gasoline seemed plausible enough. The public's insatiable appetite must have been overlooked or misinterpreted, however; we now clearly realize that, with his tremendous postwar purchasing power and his craving to ride and go places, what he really wants is more and more gasoline of adequate quality. The petroleum industry, after years of striving for increased business, has learned to sympathize with the Hindu of old who wished for an elephant and who, when he finally acquired one, found that he had on his hands the problem expressed by this rhyme:

The elephant ate by night,
The elephant ate by day,
But try as he could to fill the beast,
The cry was still, "More hay."

High-octane fuels, however, are not necessarily out of the picture for good. The newspapers have recently carried items describing the high-compression engines to be brought out by one or

The aircraft engine seen through the window in the picture above tests the performance of aviation fuel.



An aerial view of the Whiting Research Laboratories of the Standard Oil Company of Indiana in Whiting, Indiana. In the foreground are the office building and main laboratory. To the left and rear are the laboratory for work on grease and specialties and the process laboratories for work on catalysts, chemicals, and general petroleum processes. This research center will ultimately house 340 scientists and 800 technicians and assistants.

two manufacturers within the next few months. These engines, it is stated, embody basic designs that initially operate on available fuels, but that may be adapted to 90, 92, and even higher-octane fuels as such fuels become available. The designers claim that these engines will give enough additional car miles per gallon to more than offset the decreased yield of such gasoline from crude. The high-compression car will be acceptable only if it can secure its fuel whenever and wherever needed. The fuel must precede the car. As matters now stand, this can be accomplished only by progressing in steps that permit a useful increase in vehicle performance but at the same time permit the petroleum industry to make enough gasoline to meet the requirements of the other cars on the road.

Earlier in this discussion, reference was made to the fact that the gasoline problem cannot be considered apart from the other distillate fuels. Developments in the fields most importantly affecting the demand for distillate fuels are given in Figure 1.

The fact that much more diesel fuel is being used must be apparent to all. Diesel locomotives have replaced steam on many of our principal trains and there has been an enormous increase in diesel switchers. Actually, however, the diesel fuel demand is not such a large figure as compared with the truly enormous gasoline and heating oil uses.

In the field of home heating, the greater share of the increase has occurred since the war. In the case of home space heaters particularly, the rise has been so rapid that accurate predictions are impossible. Conservative interpretation of the available information would indicate, however, that the increase in the use of oil-fuel space heaters will be governed solely by the availability of fuel. How this situation must affect the petroleum refiner should be clear to all—it will not be desirable to neglect heating demands in order to make improved gasoline, which in turn would be appreciated by only a few per cent of the cars in service.

Passenger car gasoline mileage presents a curious paradox from the engineer's point of view. If questioned, almost any owner will say he is concerned about gasoline costs, interested in fuel consumption, and perhaps proud of his car's fuel mileage. On the other hand, he obviously does not place much importance on fuel mileage when he purchases a car. At that time, fuel economy runs a poor second to comfort, performance, and esthetic considerations. It has been said that most automobiles are bought by women, for women, or to impress women. This may not be literally true, but certainly automobiles are advertised on the basis of glamour and performance, and are apparently purchased on that basis. Only after the car has been acquired does the owner evince the slightest interest in its appetite.

(Please turn to page 40)

Use	1938	1948*	%Increase
Motor vehicles	30,000,000	39,000,000	30
Diesel locomotives	300	5,200	1650
Oil burners for home heating	1,700,000	4,200,000	300
Oil-burning space heaters	Less than 1,000,000	5,500,000+	450

*Estimated

Figure 1

Blueprint for Economics Education

by PEARCE DAVIS*

THE department of business and economics at Illinois Institute of Technology has recently undergone an extensive program of reorganization, expansion and development. This program began in March, 1946, and has been carried forward at a rapid pace since that time. It is to be emphasized, however, that although the department's recent expansion has been rapid, it has proceeded under a carefully considered plan of development. This blueprint for the department's future was evolved and put into effect only after a realistic analytical appraisal of the present and probable future position of Illinois Institute of Technology and, perforce, the department of business and economics, in the American educational world in general and the educational world of the Middle West in particular.

Some measure of the department's development during the last two years may be gained from the growth of the business and economics faculty. In March, 1946, there were four members of the regular instructional staff. At the present time there are 13 full-time departmental members and five to six part-time members. A substantial number of those members classed as part-time teach from one-half to three-quarters of full schedule. In addition to the day staff there are 17 other faculty instructors serving the department in the greatly expanded evening program. The total departmental faculty thus numbers approximately 35 men and women.

During the last two years, also, the department's undergraduate curricula have been wholly revised and much enlarged, new graduate programs have been established (for the benefit of both engineering and science and business and economics graduates) and all course offerings have been replanned, rewritten and elaborated. Numerous new optional specialized curricula (to be selected at the end of the freshman year) have been designed for students majoring in business and economics. At the same time, the new and enlarged course offerings of the department have been integrated with and made available to the recently established management options programs, offered by the engineering and science departments. Further, a substantial number of new economics courses have been instituted for those engineering and science students who wish to select such courses under the liberal studies elective provisions of the present engineering and science curricula.

As a result of all these recent developments, the department of business and economics is now one of the larger departments of its type in the country. It offers a complete program in the business and economics fields, both undergraduate and graduate, with particular facilities for students with engineering and science backgrounds. In short, the department now stands well-equipped and ready to compete with other leading institutions for the preeminence that it seeks.

The Department's Role at Illinois Tech

The role of the department of business and economics at Illinois Tech is five-fold.

First, as an integral part of the Division of Liberal Studies, it offers broad and basic education, terminating in the granting of the bachelor of science degree, to highly qualified students majoring in the fields of economics and business. In performing this function, the department is carrying forward the traditions of Lewis Institute of Arts and Sciences and the specific mandate of the will of Allen C. Lewis, founder of Lewis Institute.

Secondly, the department acts as a service agency in providing for engineering and science majors a portion of the broad general education that is the objective of the liberal studies requirements now incorporated in all engineering and science curricula.

Thirdly, the department provides courses in management or business subjects for those engineering and science students electing the management option curricula within their departments.

Fourthly, the department offers graduate work (beginning in September, 1948) leading to the degrees of master of science in business and economics, and, master of science in business and engineering administration.

*Professor and chairman of the department of business and economics at Illinois Institute of Technology.

The business and economics department "seeks a position of preeminence among leading collegiate institutions of the country and especially within the ranks of its brother technological colleges".

Fifthly, the department has the responsibility of serving in all four of the above-listed capacities for the benefit of evening session students. In discharging this last function, it contributes its share towards Illinois Tech's adult education program in the Chicago area.

These five roles vary in their purposes and goals and hence will be explained separately.

Education for Careers in Business and Economics

In so far as its own undergraduate majors are concerned, the objective of the department is to provide both broad, fundamental general education and basic professional training in the vocational area of the student's choice. All the department's optional curricula are designed to achieve these goals.

The option *general economics* furnishes a program for students who desire a general liberal arts economics major. *Labor economics, international economics,* and *money, banking and finance* are designed for more specialized interests but are related to the *general economics* program. *Accounting, statistics,* and *economics and business research* have been planned for students who expect to follow these avenues of professional activity; all three supply educational background for service with either private industry or governmental organizations. The *business management* and *industrial relations and personnel management* options have been formulated for those interested in managerial, administrative or executive aspects of American industry.

In addition to the foregoing, an option in *public utilities and transportation* is available to those desiring specialization in these fields. Furthermore, an option in *market research and development* is in the process of development and will shortly be open to qualified students wishing to concentrate in the marketing phase of American industrial operations.

For Engineering and Science Majors

Illinois Institute of Technology has been a leader among technological colleges of the country in recognizing the need for general education in modern engineering and science education. Accordinly all engineering and science curricula at Illinois Tech now carry requirements for a specified number of liberal arts courses. In order to augment the usefulness of engineering and science graduates to their communities and to make them more understanding and valuable citizens of their country, the following Liberal Studies division courses must be taken by all such students regardless of department:

English 101, 102—Reading, Thinking, and Writing; Business and Economics 101, 102—Principles of Economics; Political Science 420 — The American Constitutional System; An elective course in the humanities, and two additional elective courses in liberal arts subjects.

All departments in the Division of Liberal Studies offer courses eligible for liberal studies election. The department of business and economics supplies a substantial number of choices; all of the courses offered for such purposes are subjects that are regularly given in departments of economics in leading liberal arts colleges. Examples of these offerings include:

Economic Geography and Resources; American Industrial History; Development of Economic Thought; Basic American Industries; Economics of the Industrial Firm; Federal Budget and Fiscal Policy; Urban Land Economics; Money, Banking and Prices; American Labor History; Public Utilities; Current Economic Problems; Prosperity and Depression; Govern-

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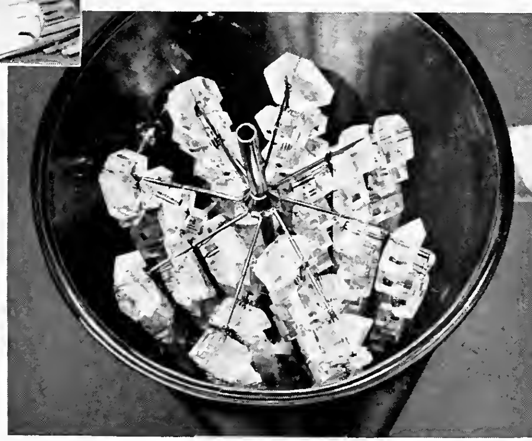
Newsworthy Notes for Engineers

Red Light stops trouble-makers

This girl is using a test set designed by Western Electric engineers to detect defective fuses which would pass ordinary tests. X-ray studies of bad fuses showed broken fuse wire as the usual cause of failure, but that 90% of the time, the broken ends made sufficient contact to test O.K. unless the fuse was vibrated. In the new test set, the fuse is struck ten times a second with a force of 250 grams causing the broken ends to separate—an "open" for as little as ten micro seconds, lights a red light—and the fuse gets no chance to make trouble in telephone service.



Bumper crop of crystals grown from seed

Here you see a tank-full of synthetic EDT (ethylene diamine tartrate) crystals ready for harvesting at Western Electric's Electronics Shop. These have been held at a fairly constant temperature for several weeks and have swished back and forth in the solution in the tank, growing from tiny seeds into chunks the size of your fist. They will now be processed into crystal plates to filter various voice channels—nearly 500 separate conversations—traveling over the same long distance telephone circuit. Setting up equipment and working out precise controls required in growing crystals was an interesting problem for Western Electric engineers. This year's crop will produce a million or more crystal plates.

Engineering problems *are many and varied at Western Electric, where manufacturing telephone and radio apparatus for the Bell System is the primary job. Engineers of many kinds—electrical, mechanical, industrial, chemical, metallurgical—are constantly working to devise and improve machines and processes for mass production of highest quality communications equipment.*

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

You Can Read Faster . . .

(Continued from page 8)

aware of your difficulties, and if the instruction is adapted to your *individual* needs. As with medicine, no cure is effected unless properly prescribed for you and no one else.

Improving Reading Skills

The diagnosis is a means to an end; it determines the extent and limitations for improving your reading and makes possible better instruction to match your individual needs. In the instruction that follows the diagnosis, there is no one book, method, or instrument that can be turned to as a panacea for all reading difficulties. If this were true, there would not be such a large number of adults needing reading training.

Instruction in reading may cover any one, all, or any combination of the following skills: word recognition and analysis, vocabulary meanings and enrichment, comprehension, and speed.

The reading training program makes use of a large number of printed materials and instruments. Best results with these instructional tools are obtained through individual work.

Vocabulary enrichment can be taught primarily through the use of printed materials. As you enrich your reading vocabulary, dividends will also be realized in your written and oral expression.

Instruction in comprehension includes learning how to do the following more efficiently: (1) *find the main ideas,* (2) *locate important details,* (3) *follow directions,* (4) *draw conclusions,* (5) *make inferences.* In definite lessons you can learn techniques that will help you understand how to make use of each of these skills. Also, it should not be overlooked that improved comprehension and an increased speed of reading are the concomitant results of a better vocabulary.

Two instruments are used in an effective reading training program: (1) *the tachistoscope* and (2) *the reading rate controller.* The tachistoscope is a flash-meter device for increasing or widening the eye span. Its use in rapid recognition in a broader peripheral span has also been found exceptionally effective for training Army and Navy pilots in aircraft recognition. As the eye span is increased by the tachistoscope, the length of each fixation time is decreased. Tachistoscopic training teaches you to see things as a whole rather than piecemeal. The flash occurs so quickly that it is impossible for you to see parts or to vocalize. This device projects images—forms, digits, words, phrases, and sentences—on a screen for a brief interval through a shutter on the flash-meter. The duration of this interval ranges from one to one one-hundredth of a second.

The reading rate controller is another mechanical device for speeding up reading. The range of speed on the rate controller varies from approximately 75-2000 words per minute. The reading materials used on this device for training purposes should be books in which you are interested. The rate controller is designed to develop rapid eye movements across each line and to eliminate regressive movements. Through training on the rate controller and the tachistoscope you learn to read faster and comprehend more accurately because you are able to grasp larger thought units at one time. Rapid reading is also a boon to *concentration,* for you perceive in wholes in less time.

Any good reading program recognizes that you read for different purposes, such as, *skimming, leisure enjoyment, locating the central idea,* or for *thorough understanding.* Naturally, your rate is adjusted to the purpose for which you are reading, but once you have succeeded in eliminating vocalization and passed the 250 words per minute mark, you will be able to do your thorough reading even more rapidly than before. A fast reader has a flexible rate dependent upon his purpose, but a slow reader, or vocalizer, reads everything at the same rate because he is a victim of habit.

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(Continued from page 24)

Application of Reading to Your Job

It is not difficult to realize what it would mean to double your rate and comprehension of reading. Department heads or supervisory personnel almost invariably find that they cannot cover all the reading material that comes across their desks. Often the executive hires a secretary to do this job for him without knowing whether her reading ability is up to the level of the material she is forced to read. Vocabulary plays an important role in the executive's selection of words that say or write clearly and exactly what he wants to say or write. Also, the readability of the materials being written should be subjected to one of the good *readability* measures now available. Management and employee relations depend greatly upon whether or not the message from management can be read by those for whom it is intended.

Stenographic help and correspondents make use of a large number of reading skills. They must skim an order letter to find out the exact item requested, and they also must be able to read thoroughly to prepare a report on the product with which they are concerned. A secretary with a limited vocabulary forces her employer, perhaps quite unconsciously, to lower his level of dictation to her level of vocabulary. Spelling errors are often explainable by vocabulary difficulties—such as saying *excape* for *escape* or *preserve* for *perverse.* Because of reading limitations, the secretary often fails to meet her employer's standards; this may be the real cause for her irritability, dissatisfaction, and ultimate frustration.

Then there are the engineers, scientists, or other professional persons who must keep abreast with professional papers on research. Often the very nature of their reading has caused them to become vocalizers, or word-by-word readers. As the material to be read increases in amount and complexity, one begins to feel completely "swamped" or perhaps discouraged because he cannot cover all these materials. It is almost impossible for an engineer or scientist to break his word-by-word reading habits without definite re-training because there will always be formulae or highly scientific terms that keep him from seeing and reading entirely in wholes. At the same time, the scientist and engineer like to read material for leisure and personal enrichment in addition to professional literature; this he could cover more rapidly than he does by his word-by-word approach.

Inspectors, key punch operators, ticker tape readers and filing clerks are among the many others for whom reading training, resulting in an increased span of recognition, has definite job applications.

The thing to remember is this—no matter how well you read, you too can learn how to read faster and learn more. Increased reading efficiency means greater personal pleasure, increased knowledge, and greater job success.

Magnetic Records . . .

(Continued from page 10)

Voice Snapshots

In the earliest days of photography the equipment was so bulky that pictures were made only in a studio by a professional photographer. The coming of the box camera changed this situation. A person could then bring his camera to picnics, parties, convention, etc., and make a collection of snapshots which he preserved in an album to show his friends.

An analogous situation exists with sound recording. We would like, of course, to preserve baby's first words, and father's speech when he was made grand sultan of his lodge. But a little further reflection will indicate that on almost every occasion when a picture snapshot is taken, a recording or "voice snapshot" would also be interesting. In many cases the sound might be more important than the picture. The concept of "voice snapshots" seems rather strange at first, but that is mainly because we are unfamiliar with it.

A pocket model recorder which can be taken anywhere and used for "voice snapshots" is shown in Figure 2. It contains its own power supply which runs it for about two hours. The records taken with such a machine would of course be edited, and a introductory explanation of the time, place, and occasion would be inserted if necessary.

Amateur Photography

While amateur photography is more properly classed as a hobby, most people use the results for entertainment of themselves and their friends.

Many who take colored slide-photographs have arranged programs on magnetic records to go along with the sequence. Such programs have appropriate background music, and the scenes are described by the people who took them or who are in them. Sounds and interviews recorded at the scene when the picture was taken are used for added interest.

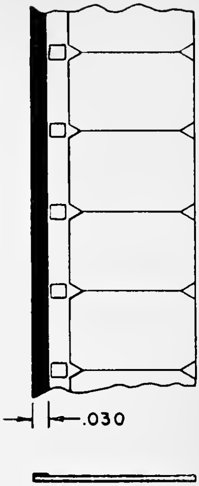

Figure 4. An eight mm. magnetic sound film.

With magnetic recording the amateur can make his own 8 millimeter sound movies. The sound track is a magnetic coating on the film edge, and may be added to old films in one's library, as well as to new shots. Figure 3 shows an eight mm sound projector and Figure 4 shows the film used with it.

Any movie amateur will testify that titling his pictures is a laborious and disagreeable task. On the other hand, a running narrative for sound film is almost as much fun to make as the original picture. Those who hear an 8mm amateur sound movie, and are later shown the present type silent pictures, say that the contrast is so remarkable that they would never go back to silent films.

As we stated earlier, magnetic recording should not be considered a substitute for the phonograph, especially for short selections and popular music. It does however, have these certain characteristics that are especially suitable in home entertainment.

A Community Mobilizes . . .

(*Continued from page 13*)

and September. The same was true for the teachers who vacation the last two months in the summer.

It was mentioned earlier that Rockford College had reached the saturation point prior to the arrival of the engineering students. At the present time the condition is not too acute, for additional class room space is rented from the Board of Education.

An athletic program was organized, with basketball the major sport. This of course put an additional burden on the budget; however, the morale building power was felt throughout the entire student body.

The college girls and Tech boys do not attend coeducational classes; therefore, it takes a considerable length of time for them to make acquaintances. Recently they have collaborated on college functions and, where the men had at one time felt as intruders, they now feel that they have an active part in the college life.

It may be interesting to note that the transfer of these students from Rockford to Chicago is handled with the smallest amount of unnecessary registration procedures. Students attending school at Rockford are considered to be students of Illinois Tech, not of Rockford College. Grades are kept on file in the coordinator's office on Illinois Tech grade cards. During the semester preceeding the student's transfer to Chicago, the registrar from Illinois Tech comes to Rockford and pre-registers all students as it is done on the Chicago campus. Grade sheets, test results, personal data, and veterans information are forwarded at the time the student reports to Chicago.

Transcripts for students desiring to change institutions are handled in the following manner: a photostatic copy of the student's record is made in Rockford and sent to Chicago for the recorder's signature and the school seal. If a student withdraws from the program, a photostatic copy of his record is made for the files in Rockford and all original forms are forwarded to the registrar's office in Chicago. It would be well to state that the coordinator is employed by Rockford College, but holds the rank of associate professor at Illinois Tech in Chicago.

The future of this program at the present time seems to be in the hands of the federal government. No one can predict exactly what the draft law will do to the program. However, it is hoped that it will not have the same effect that it had on the colleges from 1941 to 1945.

This program has opened new vistas of hope and ambition for many young men who had never dreamed they would have the opportunities afforded by higher education; they will be better men for their employer, themselves, and the community as a whole.

Sports and Illinois Tech

(Continued from page 16)

How about the coach? Partly perhaps, but also only indirectly. Neither did he create the situation and most every coach I know would be happy indeed to see the game become amateur again. Life would be much easier if he were not forced to dig in the hinterlands for prospective all-Americans, lure them to his school, keep them eligible and happy, and then try to mold some of these well-paid, spoiled young individualists into an efficient team. I do not think that most of the subsidized athletes are spoiled individualists, but those who are become big problems. All of this is a part of a modern coach's job. He must accept that part to gain his share of victories; and he must gain his share of victories to keep his job. You might ask why an idealistic person would stay with that sort of job; but if you do I think, by the same thought, you would have to apply that very question to our writers, lawyers, artists, musicians, or to people in almost any profession that is rather in the clutches of our predominant materialism.

Are the athletic directors to blame? More so than the coaches, I think, because their responsibilities are greater and because their jobs entail supervision of the more philosophic phases of athletics. But they are under similar pressure.

The public? Yes, to a great extent. But it is always so easy to blame the Beautiful People and then forget about it. Anyway, it would take a full-scale spiritual revolution to help much here; I see none in the offing.

The college administrators? These are the gentlemen who could do most to improve the situation and they are doing very little. Some courageous stands have been taken by individual institutions, but it would require much less courage from any one person or institution, and greater results would come of it, if the administrators of the majority of large colleges in the nation united for a clean up. The lone college president is inviting unemployment with such a stand, for his alumni and (or) state legislators are not going to stand by and watch the college become a pure loser while the rival schools continue recruiting, subsidizing, and winning. However, together the administrators could, I think, swing public sentiment. With the greater number in the fold to begin with, the others would probably be pressured in eventually; or they could remain "outlaws", if they chose, a kind of group of semi-professionals playing among themselves.

A clean-up of the proper kind would not greatly disturb the quality of the play or coaching, or the color and appeal and intensity of intercollegiate sport. Most of us, I think, want very much to keep all of these. Of course, one could not expect the movement to be perfectly effective at all times, but

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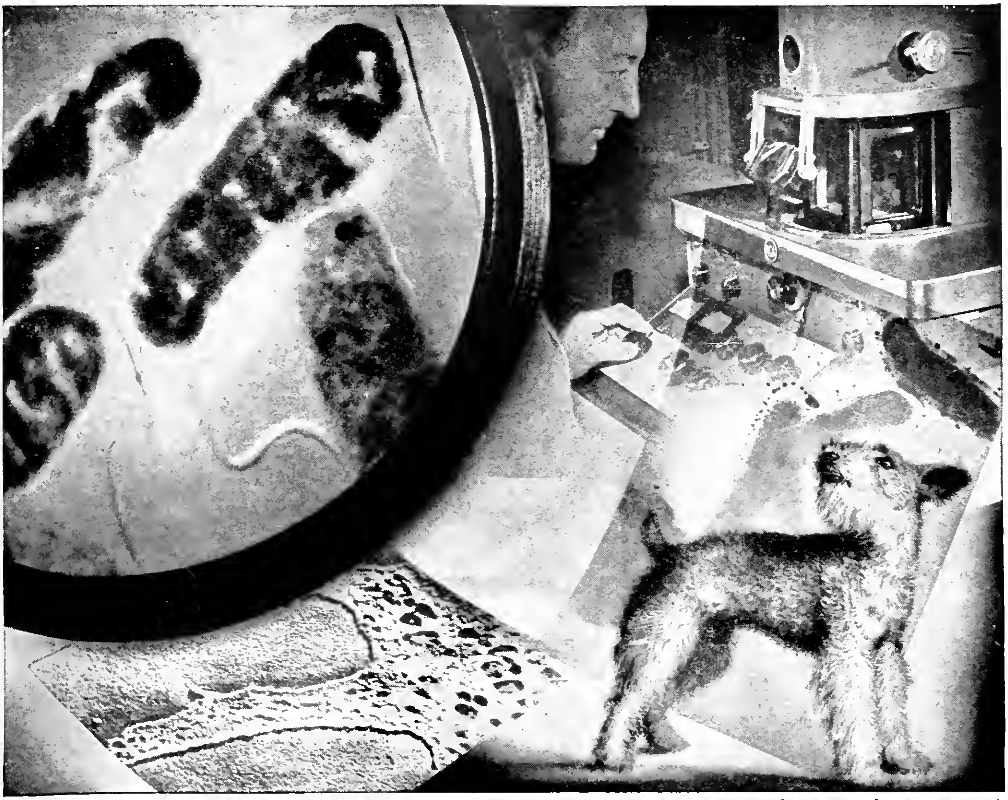

Electron microscope, perfected at RCA Laboratories, reveals hitherto hidden facts about the structure of bacteria.

(Continued from page 32)

at the very least it would retain control of a situation that is certainly in a state of anarchy now; with proper, consciencious supervision by the individual presidents, college athletics can be placed and kept on a much higher ethical level.

Specific details of the proposed clean-up would be far too numerous to be outlined and discussed in this article, or, for that matter, probably in the entire magazine. In any case, they would be the problem of the administrators, and undoubtedly it would require a great deal of effort, debate, patience, and compromise on the part of the administrators before a definite program could be agreed upon. All, I think, would wish to eliminate the "tramp athlete", the boy who is enrolled merely because he is paid for his athletic services, the lad who is only theoretically attending school or who is given a scholastic program that would not puzzle the average third-grader. There would probably be much more discussion and disagreement on athletic scholarships, free room and board, priority for part-time jobs, and the like. A person could argue convincingly either for or against such concessions to athletes, but we will do neither at this time. Recruitment of athletes by college officials would probably be stopped. Of course, the alumnus would still be free to "persuade" an all-city halfback that his particular college was the best, especially if that alumnus assured the young man that he would not be beset by financial worries for four years; nothing much can be done about this sort of thing (there are instances where no one could begrudge the boy some of this aid), but college officials would probably be forbidden to promote or facilitate these transactions as many do now.

Whatever the details, the one big objective should be clear: to rid intercollegiate athletics of the greed element; to clear out those participating in it or influencing it from the outside who are seeking merely, personal, material gain; to keep sports for the sportsmen, for those who play, coach, direct, or just watch primarily be-

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cause they love sports for the sake of sports.

If you happen to be wondering how all or any of this pertains to Illinois Tech. whose hands are quite clean, let us hasten to say that the success of the current sports revival here is dependent to a great extent upon the general athletic practices of all the schools in the country. The Institute intends to continue with clean hands. If the sentiment for a cleaner intercollegiate program grows, and if something tangible is done about it, Illinois Tech will not always remain at its present disadvantage. If conditions stay pretty much the same, or if they grow worse, the Institute will have to take its beatings with a philosophic smile and a clear conscience.

Football and Illinois Tech

Within recent years there has been a clamor among the students for a football team at Illinois Tech. The authorities have listened sympathetically, but nothing has been done about it. Why? I think the answers are fairly obvious, but let's look at the problems involved.

First, the expense. A huge concrete stadium is not necessary, the students say; a gridiron with bleachers on each side and a scoreboard at one end would be good enough. The installation and upkeep of the mere gridiron and bleachers would come to an appreciable amount of money, but that in itself might be handled easily enough. Equipping a team is another thing. In a recent issue of *Sporting News* it was estimated that a 35-man football squad could be properly equipped for $10,500 a season. That's for one season only, remember, and keep in mind also that 35 men to a squad is the absolute minimum in today's football. Now figure in the salaries of the coaches—a head coach and at least two assistants (most colleges give their varsity coaches four or five). If the coaching staff is to be worth anything it must be fairly well paid. Then there has to be a staff of trainers; football squads need at least three or four. Finally, include another neat sum for transportation, room and board while playing away from home, room and board for the squad during those three or four weeks of pre-season practice before the opening of school, game officials, publicity, and a few other items that are not so incidental.

Without a stadium gate receipts would be rather meager. Even with a stadium one could not hope for much more. In a small college town, with a civic as well as a student following, football crowds will be greater. In Chicago the situation is somewhat different. How many people, except the students and some alumni, would flock to an Illinois Tech-North Central or Illinois Tech-Concordia game when Ohio State is playing Northwestern in Evanston, Michigan is playing Illinois in Champaign, and Minnesota is playing Wisconsin in Madison, or when they can wait until the following day to watch the Bears and Packers in Wrigley Field or the Cardinals and

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(Continued from page 36)
Giants in Comiskey Park. DePaul and Loyola found it pretty tough going in Chicago; they both dropped the sport some years ago.

Actually, the expense of it is by far the least important of several good reasons why Illinois Tech has not adopted football. For instance: what sort of a team do you think a school such as Illinois Tech could turn out? Probably one that would take consistent wallopings in the weakest competition available. A good majority of our college football players are preparing for careers as coaches, physical education instructors, or recreation directors, but the Institute has no physical education curriculum for them. Football requires three hours a day for practice alone; most of the male students here are enrolled in the science and engineering curricula and the boys sometimes find it difficult to set aside a few hours each day for breakfast, lunch, and dinner. Even those schools who acquire their football material in strictly ethical fashion have a big edge to begin with over Illinois Tech and colleges like it. The Institute does not intend to lower its standards or alter its requirements, and I think that all of us will agree it should not.

And lastly, the student body, the faculty, the alumni, and the staff of Illinois Tech have not demonstrated in recent years that they can give to the athletic teams they do have the support they deserve. The general philosophy has been one of profound indifference. With this situation, neither the athletic department nor the administration will seriously consider football at Illinois Tech.

Someday perhaps, if at that time it seems wise; but not in the foreseeable future.

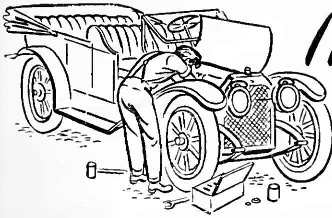
A Kind of Test

It is true that students and alumni cannot be blamed entirely for their indifference to the intercollegiate athletic program. As a rule, the students here are a busier group of people than those at most colleges; many spend two to three hours a day riding back and forth from their homes to the campus, and the time they can give to any interest other than their studies is limited. Then, too, facilities for spectators have been very poor in the past. The coming winter and spring seasons, however, will act as a kind of test. With a number of students living on the campus in the two new Michigan avenue dormitories, bleachers provided for spectators at basketball games, plenty of space for crowds at the Armour Square baseball diamond, and with a special campaign undertaken by the athletes, the athletic department, and the public relations department to make the activities of all the sports teams known to the people at Illinois Tech, there will be very little excuse if attendance and interest remain still well below that at most colleges.

Much greater cooperation could be requested of the faculty and staff, both in the matter of interest and attendance and in their general attitude toward the program. They are asked only to realize that intercollegiate athletics are a legitimate and desirable part of life at the Institute. Illinois Tech posseses a fine athletic staff, a remarkable athletic staff for a school of its size and type. And I think there is no question that, in intelligence, seriousness of purpose, and character, its athletes in all sports rank with those of any school. The coaches and the athletes both deserve much better.

Illinois Institute of Technology is a growing school, a vigorous and alert school with a bright past and a brighter future. Its broader objectives do not depend upon a championship basketball or baseball team; its ideals, in fact, limit the attainments of its athletics teams. But a stronger athletic program within those ideals—an accomplishment that should be easy enough with the support of the entire Institute — would become a further tribute to the college, another benefit to the student body, and, therefore, a benefit to the school itself.

Winning on the athletic field is not incongruous with the spirit of Illinois Tech.



It's springtime 256 times a second

Your doctor counts your pulse beat. The musician calls it rhythm. The sportsman knows it as timing. The engineer, who designed your automobile, refers to it as cycles.

The valves that admit and exhaust the gas to and from your engine are timed to form a cycle.

Spiral springs made of high-carbon round wire play a vital part in maintaining this cycle—in keeping your automobile engine running smoothly—at the torturing rate of 256 spring-actions a second.

Taken for granted today, they were a major headache to the driver of yester-year. Today's springs are as superior to the springs of thirty years ago as are the cars themselves.

Improvements came with demand and competition. No other country advanced as rapidly . . . or as far.

Just as the discovery of America was made possible by enterprise capital, so the automobile was the product of free enterprise—including the cash that buys it.

It's Springtime 256 times a second under your hood and Roebling is proud of its contributions to that engineering feat.

Roebling also is proud of *this* fact: the world over, automobile engineers have confidence in Roebling and its products.

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A CENTURY OF CONFIDENCE **ROEBLING**

Why Not Higher Octanes?

(Continued from page 20)

Consideration of the fuel mileage attained by any motor vehicle must recognize not only the ton-miles of work done but also the standards of performance and convenience. As an extreme example, the modern long-distance highway freighter may achieve as much as 150 ton-miles per gallon: an agile passenger car may average less than 25 ton-miles per gallon. The difference is to a considerable extent the price paid for flexibility, "pick-up," and, in general, the sprightly performance so highly desired in passenger cars. It is obviously possible to compromise performance of the passenger car and achieve significantly better mileage than now prevail. Actually, this has been done. There are cars on the road that weigh in the neighborhood of 3,000 pounds and that will do at least 25 miles per gallon—around 37 ton-miles. Cars producing 25 ton-miles per gallon can be sold in competition with cars doing better than 35 ton-miles per gallon chiefly because the customer prefers performance to fuel economy, at least so long as gasoline is as cheap as it is in the United States today. There are other parts of the world which are not so privileged, and where cars must be much more economical of fuel.

The car designer has two obvious avenues by which he may increase fuel mileage:

1. To reduce the weight of the car, or

2. To sacrifice speed, pick-up, and other performance characteristics.

This is not the place to consider the various sales problems with which the automotive industry must reckon. Perhaps the gasoline story can be told just as well by taking the automobile and the preference of its owners pretty much as they are, and outlining what can be accomplished under these standards. After all, changing of performance standards would not necessarily alter the problem, when considered from the standpoint of the relation between gasoline characteristics and engine design.

The new high-compression engines have been designed in such a way that they can be improved in the future and so can capitalize upon future fuel improvements. It is not generally realized that the basic designs of most of our present passenger car engines were laid down 20 or more years ago. Through painstaking and gradual improvement of engines built over these basic designs the engines have been increased materially in power and somewhat in economy. Many of these improvements have been made possible by the increase in octane number of gasoline over that same period.

There is every reason to believe that the new designs will follow the same plan. They provide an engine structure capable of operating at much higher compression ratios than present fuels will permit, and there

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will therefore be no difficulty about providing increased compression ratios when higher-octane fuels are available. This is not true of present engine designs, which have about reached the limit of the compression ratios they will stand. Higher compression ratios would make them rough or would show in other ways that the limit of their ability has really been exceeded.

Granted that the basic engine is suitable and that fuels of sufficiently high octane number are available, there is no more economical or logical method of improving performance and economy than to increase the compression ratio. This premise has underlain engine and fuel development since the introduction of lead tetra-ethyl in 1923, and there is no reason for questioning its soundness for the future.

Octane number, however, is not the only measure of gasoline quality. From the user's standpoint, it is not even the most important. Gasolines are hydrocarbon fuels having high energy content and volatility characteristics that make it possible to handle them conveniently and to utilize them in simple and inexpensive equipment. Also, motor gasolines are chemically stable and remarkably free from objectionable characteristics. On the scale of energy content, hydrocarbons come close to the top. Hydrogen has the highest heat of combustion of any known element — 52,000 BTU per pound. Of the common elements, carbon has the next highest heat of combustion—12,000 BTU per pound—so that the combination of carbon and hydrogen constitutes a very desirable energy package.

Since motor gasolines in this country have always been constituted of hydrocarbons, energy differences have not been important. Other quality differences, such as volatility, vapor pressure, octane number, etc., have been of more immediate interest. For a good many years, gasoline volatility, while recognized as probably the most important single measure of performance quality, was not given the attention it deserved. It was not until the mid-1930's that the practice was developed of with-holding the lighter fractions from summer-grade gasolines in order to reduce vapor locking in hot weather and improve starting characteristics in winter time. This practice has probably contributed more to the usefulness of gasoline, from the standpoint of the automobile owner, than any other single development.

Emphasis upon octane number is pertinent mainly because the present other characteristics of gasoline are so highly satisfactory. In a sense, this is similar to the history of the automobile itself. The finer points of riding comfort, for example, became important only after reliability, push-button starting, and basic performance requirements had been provided. So, while octane number is not by any means the most important gasoline characteristic, it is from a current practical standpoint the property with which we must chiefly concern ourselves in the present contest between the demands for volume and for quality improvement.

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Increasing the octane number from 72 to 82 permits an average improvement of about 20 per cent in engine output. A further increase, from 82 to 92 octane number, should raise output about 25 per cent more. Assuming that vehicle weights and standards of performance are not changed as octane numbers are increased, corresponding increases in mileage of 5 to 10 per cent should be possible.

These figures illustrate one characteristic of the octane number scale for rating gasoline that is not usually appreciated: that each octane-number unit becomes increasingly important as the level is raised. Unfortunately, it also happens that the fuel manufacturer is faced with progressively greater manufacturing difficulty with each unit of octane-number increase. Once upon a time, it was a relatively simple matter to add tetra-ethyl lead to the gasoline then being manufactured and increase its knock rating five to ten units. At present gasoline quality levels, however, the same amount of lead will not give as great an improvement in knock rating. Further increases in octane number necessitate going into basic refinery operations. The solutions in individual refineries will vary widely but they have several points in common: they all require expensive equipment, large quantities of steel, much time to execute, and additional sacrifice in yield per unit of crude.

The fundamental necessity of meeting existing volume demands and providing filling station service is frequently overlooked. One has only to visit some less privileged country to realize that in the United States the automobile is vital transportation and is only secondarily a glamorous novelty and a sporting device. The fundamental requirements of the automobile in this country are reliability and availability. Improvements in the more glamorous characteristics of motor fuels can be made only as they are permitted by the demands for gasoline and the other light distillate fuels that are so closely interlocked with it at the refinery.

Improving the octane number of motor gasoline is, of course, something that each manufacturer would prefer to do from the standpoint of competitive selling. However, the petroleum industry cannot place the customer upon a waiting list with the doubtful encouragement that his name may come up 18 months hence—a condition forced on the automotive industry by the national economic situation. A filling station cannot even satisfy a customer by stating that gasoline will be available tomorrow. The petroleum industry must not fail to furnish the gasoline needed to run the cars on the road today.

With petroleum companies as strongly competitive as they are, high octane-number fuels for cars not yet built will become available as soon as the laws of supply and demand permit. There is no stopping place to man's desires once he has been shown something he thinks will entertain him or contribute to the comforts of life. This fact, often referred to as the desire for increased standards of living, is—Karl Marx to the contrary—the principal reason why living in these United States has so many advantages over living in other parts of the world.

Blueprint . . .

(Continued from page 22)
ment and Economic Life, and International Trade and Economic Policy.

All of the department's courses that pertain primarily to management or business are excluded from liberal studies election. In this group are all accounting subjects, business law, personnel management and the like.

Engineering and Science Management Options

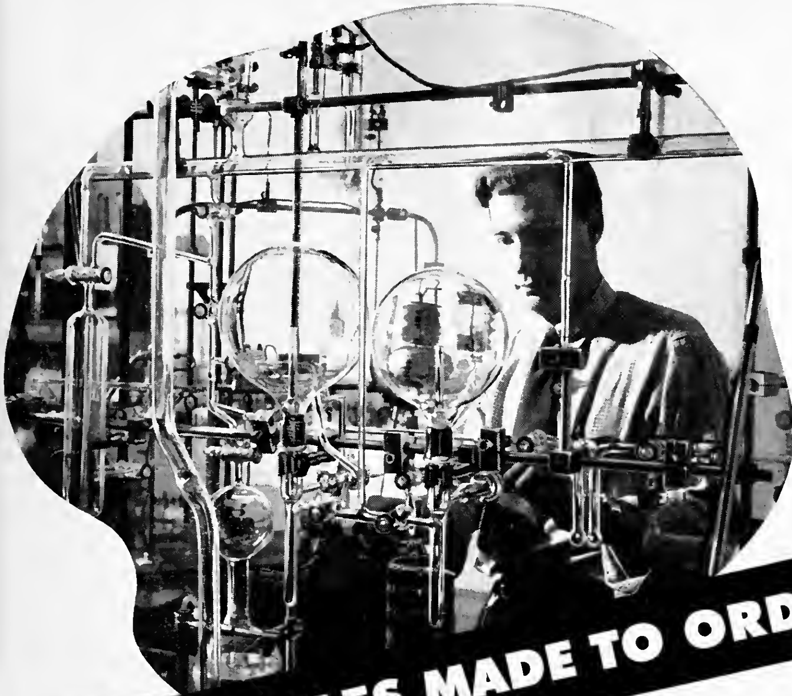
In recognition of the fact that numerous science and engineering graduates discover that they are more interested in the managerial aspect of industry than in technical engineering, many of the engineering and science departments at Illinois Tech recently established management options within their curricula. These options provide that four or five technical subjects be eliminated, beginning with the fifth semester of the student's curriculum, and an equal number of management subjects be substituted for them. The pattern of management courses provided for is designed to give the student an introductory familiarity with most aspects of business operations. The program is part elective and part required. Subjects covered include accounting, business law, personnel management, industrial relations, business finance, marketing, theory of organization and management, and engineering economics.

For students who anticipate future employment by government rather than private industry two political science courses, *The City* and *Administrative Law*, are recommended.

The Graduate Program

In September, 1948, the new graduate program of the department of business and economics was initiated. Two master's degrees will be granted, one in business and economics and the other in business and engineering administration.

The master of science in business and economics is designed for students who seek professional training at the graduate level in the broad fields of economics in preparation for specialized careers in industry or government. The general plan of study may be adapted to the students' area of particular interest; concentration is possible in such fields as *money, banking and finance, international economics, accounting, statistics, market analysis and development, public utilities and transportation, business management, and industrial relations and personnel management.* Admission to graduate study assumes that the student has a bachelor of science or bachelor of arts degree from an accredited institution, with an undergraduate major in business or economics (or the equivalent) and an undergraduate record indicating superior ability. The degree is
(Please turn to page 48)



MOLECULES MADE TO ORDER

Year by year, month by month, oil industry chemists find new, fascinating possibilities in the hydrocarbon molecules that make up petroleum. They have learned many ways to convert them into new and more valuable molecules.

One result of this experimentation has been a flexibility that permits stepped-up output of whichever petroleum products are most urgently required. When the primary need was for vast quantities of aviation gasoline to help win the war, research showed how it could be produced. In a peace-time summer, the great demand is for an ocean of automobile gasoline; in winter, less gasoline and more fuel oil are needed. Research tells the industry how to make petroleum serve the public more efficiently.

Standard Oil is a leader in petroleum research. Many remarkable developments have come from our laboratories; many more are sure to come, in the future, if we continue to attract good men, furnish them with the most modern equipment, and provide an intellectual climate in which they can do their best work.

We *are* continuing.

Standard Oil Company

(INDIANA)

910 S. MICHIGAN AVENUE, CHICAGO, ILLINOIS

STANDARD

STANDARD SERVICE

(Continued from page 46)

awarded upon satisfactory completion of both the general requirements of the Plan A program of the Graduate school and the departmental requirements with respect to courses, thesis and final comprehensive examinations. Normally it is possible to fulfill the requirements for this degree in one academic year or two semesters.

The Master of Science in Business and Engineering Administration is designed for students who have completed an undergraduate engineering program but who have become interested primarily in the administrative, financial, distributive and human relations aspects of industry rather than in technical engineering or in the more restricted production phase of industrial operations. The course of study for this degree provides professional training at the graduate level in *business organization and administration, financial organization, market analysis and development, labor-management relations, theory and application of engineering economics* and related areas of interest. Particular emphasis is placed upon co-ordination and synthesis of the student's undergraduate engineering training and graduate study in business administration. Admission to graduate study assumes that the student has a bachelor of science in engineering from an accredited institution and an undergraduate record indicating superior ability. The degree is awarded upon satisfactory completion of both the general requirements of the Plan B program of the Graduate school and the departmental requirements with respect to courses, research project, and final comprehensive examinations. The time necessary for the fulfillment of these requirements varies from two to three semesters and is dependent upon previous preparation in economics and business subjects.

On occasion the department of business and economics may be willing to accept highly qualified advanced students as candidates for the doctor of philosophy degree.

The Evening Program

The educational programs of the department of business and economics —all its courses, curricula and degrees —are being planned and administered in such a way as to be easily and fully available to students of Illinois Institute of Technology who attend in the evening session. The courses and curricula required, and the degrees awarded, are identical with those of the day session, as are prerequisites and standards of performance.

The department considers its evening session program to be of prime educational importance. It is the means whereby a college education may be obtained by those who either prefer to attend evening classes or are compelled to do so by financial circumstance. It also affords an opportunity for graduate work by those who find attendance in the day session inconvenient. Then, too, there are many single courses that prove attractive to individuals simply as adult education. Finally there are special courses con-

(Please turn to page 50)

DID WE STICK OUR NECK OUT IN 1930?

Look How Alcoa Aluminum Extrusions Have Helped Our Prophecy Come True!

On June 21, 1930, this advertisement appeared in one of America's great national magazines. "Aha!" chortled a lot of people. "Look at Alcoa sticking its neck out!"

Now, in 1948, there are many aluminum trains to ride. In the past three years alone, 450 passenger cars have been ordered in Alcoa Aluminum. 103 freight cars. 412 tank cars.

One reason for the railroads' swing to Alcoa Aluminum is typified by the big extrusion press shown above. Squeezing out intricate aluminum shapes like toothpaste from a tube, it permits big assembly savings in car structures . . . without sacrifice of strength. From the massive but lightweight beam, 80 feet long, that serves as a car side sill, down to the satiny fluted moldings around the windows, Alcoa Aluminum Extrusions find wide use.

Getting metal where it's wanted, in the most intricate of shapes, and in gleaming, lightweight, corrosion-resistant Alcoa Aluminum—these advantages have helped many an industry to production short cuts, better products.

The story of aluminum is still being written. New developments are in the making that promise as much for the future of aluminum as the promise we made about aluminum trains back in 1930. ALUMINUM COMPANY OF AMERICA, Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA FIRST IN **ALUMINUM**

ALCOA ALUMINUM 1888 1948 60 YEARS OF SERVICE

Alcoa ran the advertisement above before being able to make big aluminum beams for railroad cars—in fact, before the railroads even showed much interest in aluminum. Believing the idea was sound, Alcoa took a chance, built costly machinery to make beams, then went out and sold them. *Result:* these days you *do* ride on aluminum trains.

This is typical of the history of Alcoa. In 60 short years, Alcoa Aluminum has found its way into thousands of useful things: utensils that cook better, buildings that last longer, planes that fly faster. But this is only the beginning. New developments, now in the laboratory stage, are pointing the way to even wider uses for aluminum tomorrow.

(Continued from page 48)

ducted in the evening session for particular vocational or professional groups. A course of the latter type, being introduced by the department of business and economics during the autumn semester, 1948, is *Effective Arbitration.* This course deals with the history and current practice of practical arbitration and is expected to be of interest to many Chicagoans whose daily work brings them into contact with actual arbitration procedures.

The Students

The program of the department of business and economics has been evolved on the assumption that there would be approximately 200 undergraduate students majoring in the department. Accordingly, the department is equipped to admit approximately 25 majors each semester, on the average. The men and women admitted will, of course, be chosen on the basis of their record, aptitude and promise. The department, in short, is interested at both the undergraduate and graduate level in relatively small scale, high quality and high performance education rather than in large scale, mass production methods. To this end the department has established a four year advising system under which each student majoring in the deparement has an advisor assigned to him for the period of his student college career. The student is never *required* to consult his advisor except during the preregistration periods but is invited to consult him whenever, and concerning whatever, he desires. Although the advising system places a considerable burden of consultation on the faculty of the department, all advisers agree that it is time well spent and, from the student reaction so far received, it appears that the men and women majoring in the department think so, too.

For the welfare of the department's students generally, every effort is made to maintain small numbers in the classroom. Although the pressure of large enrollments has made this goal difficult to achieve in recent years, the department believes that it has performed most creditably in this respect, especially in comparison with what large enrollments have necessitated in many leading institutions of the country.

The June, 1948, graduating class of the department of business and economics was the largest in history. Twenty men and women received their bachelor degrees at that time. The number of majors in the department at present approximates 150; two years ago, the comparable figure was about 35. Women as well as men make up this total of majors. The department, incidentally, is much interested in expanding the number of its women majors and graduates. Contrary to popular belief, the department of business and economics, like Illinois Tech itself, is *coeducational.*

A further measure of the growth of the department on the Illinois Tech campus is to be found in the student population in business and economics courses. In March, 1946, the student population (not to be read as separate students) did not exceed 1100; in June, 1948, the comparable figure was 2100. For this increase of population business and economics majors are only partly responsible; a most substantial portion is composed of engineering and science management option students and engineering and science majors taking the departments courses as liberal studies electives.

The department admittedly has its sights set high. It seeks a position of preeminence among leading collegiate institutions of the country and especially within the ranks of its brother technological colleges. It believes it has already made substantial progress toward those goals.

New Determinations from Zeeman Patterns

Excited atoms of the chemical elements emit radiations of various frequencies depending on the initial and final energy states between which the radiative process occurs. The total number of radiations that an atom is capable of emitting is its spectrum, each individual radiation being called a spectrum line. When the radiative process occurs in a magnetic field the energy states of the atom become complex so that previously single lines now are separated into an array of closely spaced lines of different intensities, symmetrically grouped about the undisturbed position of the line. This array, or magnetic pattern, known as the Zeeman effect, uniquely identifies the energy levels between which the radiative transition occurs. It furnishes for each energy level a numerical quantity called its g-value or splitting factor.

When the Zeeman patterns of such metals as molybdenum, tantalum, and manganese, are photographed in the red and infrared regions of the spectrum, there usually appear also on the spectrograms the patterns of atmospheric nitrogen and oxygen. The relative positions and estimated intensities in the magnetic patterns of these lines have now been determined for the first time from precise measurements of spectrograms by Dr. C. C. Kiess of the National Bureau of Standards and Dr. George Shortley of Ohio State University.

Because the multiplet levels of these elements are very close to each other, the effect of the magnetic field is to displace the component levels from their positions of symmetry about the undisturbed position by amounts depending on numerical quantities, or quantum numbers, associated with the levels. As a consequence of this influence, known as the Paschen-Back interaction, the magnetic patterns of the lines are distorted out of their patterns of symmetry. In the case of nitrogen the distortions are slight; but in the case of oxygen they are so pronounced that the pattern bears no resemblance either to that of a weak field or to the triplet that results from complete Paschen-Back interaction.

The interpretation of the measurements of Kiess and Shortley has afforded an interesting application of the quantum theory to the elucidation of the Paschen-Back effect. The g-values derived for the nitrogen and oxygen energy levels are the first to be announced for neutral atoms of atomic number less than 10, or neon, and are found to conform with those required theoretically for the lighter chemical elements.

Engineering Approach to Design of Houses

Critical needs of the building industry today have caused builders to focus their attention on methods for saving material; however, available service records do not provide accurate criteria for judging how much excessive material is being used. In carrying out an extensive research program on building materials and structures, the National Bureau of Standards has made an initial attempt to apply an engineering approach to house design which does much toward solving this problem. A complete report of this research is contained in a new book, *Strength of Houses: Application of Engineering Principles to Structural Design*, just issued by the Bureau.

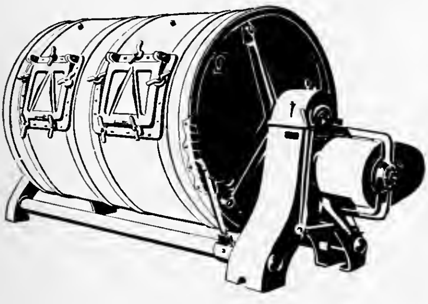
Building material is as costly as the labor required to shape and fit it into place. Application of engineering principles to the design of houses presents a complete and logical method for determining allowable loads for walls, floors, and roofs. This, in turn, makes it practicable to develop structural designs and to make use of non-conventional building materials that provide sufficient strength but require a minimum amount of material and labor. Such procedures have been followed in the construction of bridges and other large structures. Intensities of service loads are first estimated, then each material is selected to serve a specific function and to provide adequate strength at a minimum cost. In the Bureau's report, technical information (in combination with applicable engineering principles and design practices) is utilized for the benefit of dwelling houses.

For each element of a house, compressive, transverse, and racking loads were computed for typical one- and two-story frame houses in several locations representative of extreme wind and snow loads in the United States. Allowable safe loads for 100 wall, partition, floor, and roof constructions were then compared with assumed actual loads for the two types of houses in three locations. Comparisons showed that some had insufficient strength while others were much stronger than necessary. Fundamental data on the wind, snow, and occupancy loads that are likely to be imposed have also been obtained, and convenient computational methods developed for estimating the manner in which these service loads are distributed to the different structural elements of houses.

BMS 109, Strength of Houses: Application of Engineering Principles to Structural Design, by Herbert L. Whittemore, John B. Cotter, Ambrose H. Stang, and Vincent B. Phelan; 132 large two-column pages; 35 tables and 53 figures, available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., $1.50 per copy.

Another page for **YOUR BEARING NOTEBOOK**

How to turn a churn of butter better



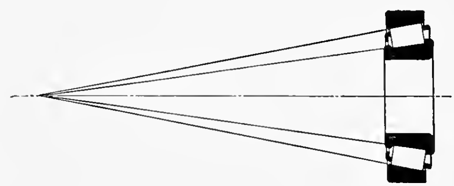
Engineers who design creamery equipment have found that a sure way to keep a churn turning smoothly, quietly and steadily is to equip all journals and countershafts with Timken tapered roller bearings.

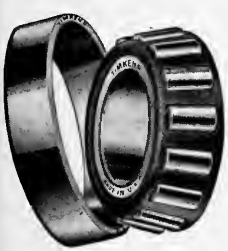
Because Timken bearings have true rolling motion and take both radial and thrust loads in any combination, the churn drive operates with less power, less wear, less maintenance. And with Timken bearings, more effective closures are possible, keeping lubricant *in* and dirt *out.*

Why Timken bearings have true rolling motion

The rollers in Timken bearings really *roll.* That's because rollers and races are precisely tapered so that all lines coincident with their tapered surfaces always meet at a common point on the axis of the bearing.

This means friction-free operation, minimum wear, greater precision. It's another reason why 9 out of 10 bearing applications can be handled more efficiently with Timken bearings.





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TAPERED ROLLER BEARINGS

Would you like to know more about bearings?

Some of the important engineering problems you'll face after graduation will involve bearing applications. If you'd like to learn more about this phase of engineering, we'd be glad to help. For additional information about Timken bearings and how engineers use them, write today to The Timken Roller Bearing Company, Canton 6, Ohio. And don't forget to clip this page for future reference.

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

"BELIEVE IT OR NOT, HOPE HAS AN INTELLIGENT IDEA!"

says CROSBY

CROSBY:

Folks, this is fantastic, but old Hope has a great idea. He thinks *everybody* ought to give U. S. Savings Bonds for Christmas presents!

HOPE:

Thanks for the kind words, son. But no kidding, ladies and gentlemen, those Bonds are sensational. They're appropriate for *anyone* on your list. On Christmas morning, nothing looks better in a stocking—except maybe Dorothy Lamour.

CROSBY:

Old Ski Nose is correct. And don't forget how easy it is to buy bonds—you can get 'em at *any* bank or post office.

HOPE:

How about it, Mr. and Mrs. America? This Christmas let's *all* give U. S. Savings Bonds!

Give the Finest Gift of all...

U.S. SAVINGS BONDS

Contributed by this magazine in co-operation with the Magazine Publishers of America as a public service.

Sock 'em with a Load of Good Cheer
Always Bring Chesterfield
Chesterfield
Chesterfield Cigarettes
Chesterfield
Cigarettes
Liggett & Myers Tobacco Co.
Give 'em by the Carton!
Give 'em to everyone who smokes—the family, the neighbors, your friends—everyone who's been good to you all year. Chesterfields are the best tip I can give you at Christmas time or any time. When you give Chesterfields you *sock 'em with a load of good cheer.*
Merry Christmas Everybody
Arthur Godfrey
ABC
Always Buy Chesterfield

ILLINOIS TECH

Engineer

MARCH, 1949

VOLUME 14 NUMBER 3 MARCH, 1949

ILLINOIS TECH

Engineer

IN THIS ISSUE

Published October, December, March and May
Subscription rates, $1.50 per year.
Editorial and Business Office, Illinois Institute of Technology,
3300 Federal St., Chicago 16, Illinois.

Contributors . . .

Friedrick K. Richter, associate professor of language and literature at Illinois Tech, received his doctor of philosophy degree at Breslau university, Bonn, Germany. In 1937, Dr. Richter came to this country and four years later joined the Illinois Tech staff. As a painter and writer Dr. Richter has received recognition in both the United States and Europe. A volume of his short stories, *Wenn du druben bist, (When You Are Over There)*, was recently published in Stuttgart, Germany. Dr. Richter's article, "Hermann Hesse; Nobel Prize Novelist," which appeared on the October, 1948, issue of the *Illinois Tech Engineer*, has been selected for the "Introduction" to Hermann Hesse's novel, *Die Heimkehr.*

William H. Harrison, Jr., and **James W. Fairchild,** instructors in the department of business and economics at Illinois Tech, are both members of a consulting firm, Social Research, Incorporated, and both are engaged in psychological testing and human relations training for supervisors and executives. Mr. Harrison, professorial lecturer in business management, joined the Illinois Tech staff in 1947 after receiving his bachelor's degree at Dartmouth and his master's at Columbia university. Mr. Fairchild began teaching at Illinois Tech last year. He received his bachelor's degree at Northwestern university.

Elmore S. Pettyjohn, director of the Institute of Gas Technology at Illinois Institute of Technology since April 1945, obtained four degrees, A.B., B.S.E., M.S.E., and Ch.E., at the University of Michigan between the years 1918 and 1922. He was associate professor of chemical engineering at Michigan before joining the armed forces in 1940. During his overseas duty as a Navy commander, he did research on both solid and liquid fuels, was head

Cover Picture: The new Chemistry building in the springtime, looking northwest from 33rd street near State street.

of the Oil Section of the U.S. Strategic Bombing survey, and served as liaison in the U.S. Naval Technical Mission. He has recently completed research projects on the use of bituminous cokes, evaporation, and heat transfer. A previous article by Mr. Pettyjohn, "Institute of Gas Technology, Research Activity", appeared in the 1946 summer issue of the *Illinois Tech Engineer.*

Leslie R. Hedrick, professor and chairman of the department of biology at Illinois Tech, was on the faculty at Whitworth college for seven years before joining the Institute's staff in 1939. His educational background includes an A.B. at Eureka college, an A.M. at the University of Illinois, and a Ph.D. at the University of Michigan. During the past two years, he has published several articles on bacteriology and micro-biology in "Food Technology" and "Journal of Biological Chemistry", national magazines. At present he is chairman of the speaker's bureau for the Institute of Food Technologists, a member of the executive council of the Chicago section of Food Technologists, and a member of the council of the Society of Illinois Bacteriologists.

• ***TO OUR READERS:***

You are cordially invited to attend Illinois Tech's annual Open House at Technology Center April 27, 28, and 29.

On those three days the laboratories and class rooms of the college, Armour Research Foundation of Illinois Institute of Technology, and the Institute of Gas Technology will be open from 1 p.m. to 10 p.m. to all friends of the Institute. Last April more than 25,000 persons attended.

Feature of the three-day affair is the great number of exhibits portraying the latest advances in science and technology. Each of the departments, including those of the college's liberal studies division, will present an exhibit or function of some type.

Visitors will also have the opportunity to view the latest structures in Illinois Tech's $15,000,000 campus development program which is designed to make Technology Center the "most modern college campus in the world".

The Editors

A Visit With Grandma Moses

WHEN Dr. Walter Hendricks, former chairman of the language and literature department at Illinois Institute of Technology, now president of Marlboro College in Vermont, invited me to teach in a summer session at his new school, I accepted at once. There were many reasons for my quick decision. I was curious to see how his new school had developed, how his progressive plans had been translated into action. I also recalled the Vermont mountains, which I had visited before, as a landscape that makes me feel at home. They remind me very much of my native province Silesia in Germany. Another reason was the fact that right near Marlboro, where I was to teach, a wonderful old lady lives and works and does the finest canvases of her type of art, and that is Grandma Moses. Yes, Hoosick Valley is located along the Vermont state line near Bennington, which made Grandma Moses almost my neighbor for a summer.

I wrote to her, soon after my arrival, asking whether I could come over with my students for a visit. She invited us to be at her home on July 20. We drove over in seven cars packed with students and picnic necessities, for we had planned a little stay at the Bennington battlefields before visiting with Grandma Moses. At two o'clock in the afternoon we arrived at the very simple farm house, which is surrounded by maple trees and from which one can overlook the Hoosick Valley and the Vermont mountains in the distance. Behind the house are stables and barns which seemed to be unused, or, at least, little used. While we stood around the house and admired the distant chain of dark green mountains (which seemed so familiar, since they are the decor in so many of Grandma Moses'

*Associate professor of language and literature at Illinois Tech.

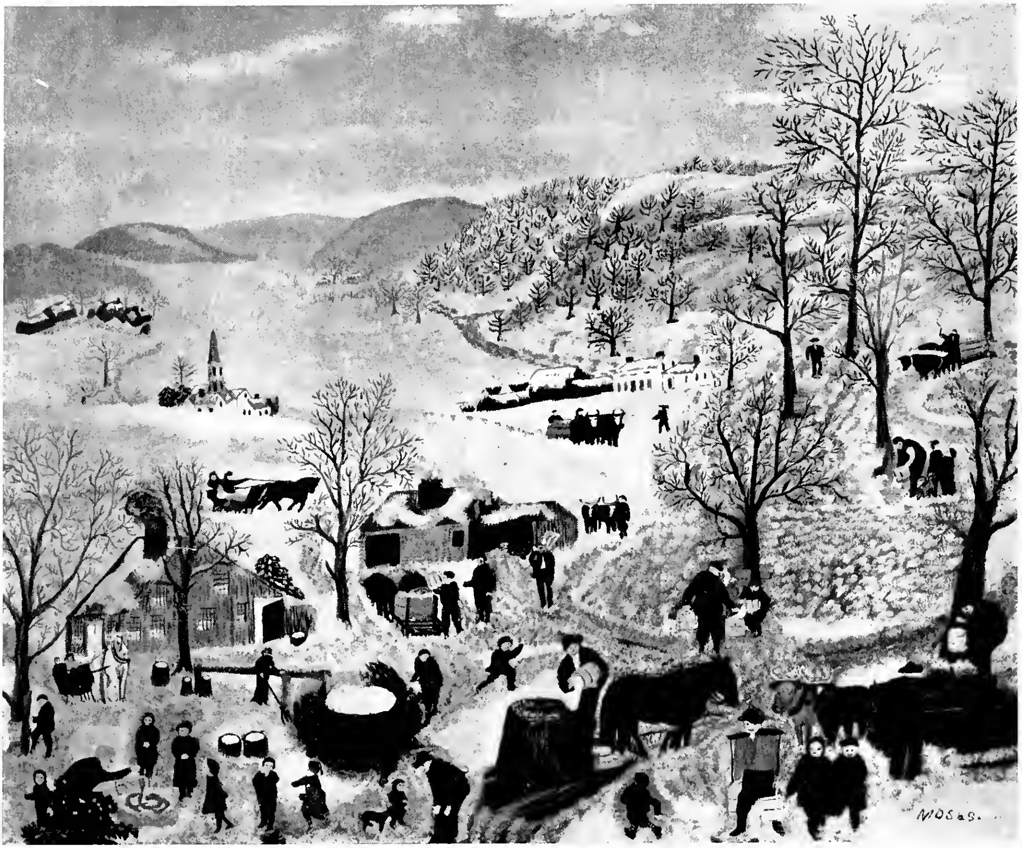
by F. K. RICHTER*

pictures) the door opened and Dorothy, the daughter-in-law, welcomed the group of excited guests. We soon were in Grandma's living room, a plain and modest place with a piano on which her latest oils, those she had done during the last few days "on order" for an exhibit, were displayed. There was also a sofa in that room, and a picture done in needle work (obviously by Grandma herself, because needle work was her chief hobby) which read, "Without Cross No Crown". All this, particularly the verse in needle work, lent the whole picture a typical Scottish-Protestant air, and Grandma Moses, being of Scotch descent, seems to be one of the fine specimens of Calvinistic cast.

While we were looking at the oils on the piano—they all were winter scenes—the door from the hallway to the living room opened and a little lady appeared, somewhat confused by all the noise and commotion a class of two dozen students can create. It was Grandma Moses. She soon had lost her bashfulness, said hello to everyone, entered into conversations, and started telling a few anecdotes concerning her pictures. Her pictures don't need any explanation; they all tell their stories quite clearly—stories of happy days, of her youth, of those days and years when Grandma lived in the Shenandoah Valley, or when she still was able to go to the forest to cut her own Christmas tree. I had taken along a little ten-year-old girl, quite talented in painting, and Grandma quickly opened her heart to the little one, pointed at her pictures, and said: "Do you see the covered bridge over there?—Do you know that good old song: 'Over the bridge and through the wood, trot fast, my dapple-gray! —we seem to go—extremely slow—it is so hard to wait!'—And over there do you see what those boys are doing? You don't see it? O, they're catching frogs. Don't you like to eat frogs? They are wonderful, their fat shanks so delicious, o, yes, they are delicious! —And do you see, my little one, do you see what those boys are holding in their hands? Those are pieces of flannel, and with flannel you can catch frogs, those big ones, fat ones. You can catch really big and fat frogs only with flannels,—never have I caught them any other way, I assure you!—and the flannel must be red, the brightest red!"

And then Grandma showed us another new picture with maple trees and men in boots doing the maple sugaring. "Yes", she said, "that is the most wonderful time of the year, the sugaring is the most wonderful time. When the snow glitters like tinsel on a Christmas tree and like the white coat of the most wonderful little princess in the picture books, and

Home in the Spring Time, by Grandma Moses. Copyright by Galerie St. Etienne, 46 West 57th street, New York City.



Sugaring Off, by Grandma Moses. Copyright by Galerie St. Etienne, 46 West 57th street, New York City.

when the men put on their high boots and hang the pails on the maple tree, —oh, yes, that is the most wonderful time of the year! And when we were children and heard the fire flicker and sing under those big sugar boilers, and when Mother told us to pour some of the syrup on the white snow around us, so that it would become hard and we could eat it as candy,—oh yes, that was the most wonderful time!"

Grandma Moses did not tell us really anything about her way of painting. She spoke only about her life, her happiness. Occasionally during the conversation I tried to lead her to the subject of her way of painting and I mentioned the book about her and her work published by Doubleday[1]. "Oh, that book!" she would answer, "that book, I don't read it"—and quickly she would add, "I don't go to picture exhibits either. Never do I go to any picture exhibit!"

While the students were listening calmly to Grandma, Dorothy, the daughter-in-law, beckoned to me to come to another room where there was another large picture which Grandma had painted for her. It was a masterpiece of Grandma's, such as I had not seen before; it represented life in Hoosick Valley, depicting groups of maple trees, small farm houses, busy farmers and workers, barking dogs, and cows that seemed to be annoyed by the barking of the dogs. All the love of a home-loving woman was poured into that canvas, of a house wife, who does not know anything else but her farm, her cattle, the distant mountains, and the joy and sorrows of family life. And that is exactly the theme that Grandma wants to depict in her work. She told me that she could not paint anything else but her own life, her own wash day, her maple sugar day, and the catching of the fox near her house.

The students had gradually come into the room in which this masterpiece was hanging. I noticed that it touched all of them, even those who had not seen "too wonderful a thing" in the pictures on the piano. I recall that that patricular picture released a tremendous longing in me for my own

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[1]*Grandma Moses, American Primitive*, forty paintings with comments by Grandma Moses, together with her life's history; introduction by Louis Bromfield, edited by Otto Kallir. Doubleday and Company, Inc. Garden City, 1947, New York.

Engineers and Unions

by JAMES W. FAIRCHILD and WILLIAM H. HARRISON, JR.*

ENGINEERS unionize? Why should they? Engineers are management people. They are important members of management's staff. They can't unionize! Beside that, there are all kinds of opportunities ahead today for young engineers. What can they gain by joining a union?"

So goes a fairly typical management attitude to the question of the unionization of engineers. Yet, the fact remains that engineers are forming unions and are carrying on collective bargaining negotiations with management.

Why? We shall address ourselves to this question. At the outset we sould like to make it perfectly clear that we are not discussing the ethics of the question. Rather, we prefer merely to explain why there should now appear a cleavage within the ranks of traditionally management people.

So far this movement appears to be confined to engineers working for large corporations and the government. According to a recent publication of one union, the trend has taken hold in such industries as electrical manufacturing, oil, radio and government service, to give only a partial list.

Even though the movement seems to be localized in the larger corporations, there are indications that a wave of discontent is mounting among the professional and office employees in industry generally. No one can predict what the outcome will be. Future events alone can determine whether or not strong professional organizations of engineers and technicians (the word "union" is not heavily stressed) are to grow out of this discontent.

It is certain that the C.I.O. and the A.F. of L. are laying the groundwork for intensive organizing campaigns to tap this rich market. At their national conventions held last summer and fall, both unions announced plans to organize technical and clerical employees throughout the land.

However, it is highly unlikely that engineers will be very receptive to the overtures of the big unions. They tend to feel that their problems are unique and will not be handled intelligently by traditional union methods and leaders. They seem to prefer their own organizations in which they can develop their native tactics and strategies.

The growing strength of the engineering organizations cannot be shrugged off by management. One of the authors of this article recently sat in on a meeting of one such unit that was being formed in a large Chicago plant. In less than three months the organization had signed up more than one-third of the company's eligible engineers; they had not had even enough time in which to adopt a constitution. Nonetheless, at this meeting the temporary officers presented well-advanced plans to amalgamate with other engineering organizations in the same company, forming a national company-wide bargaining unit. The speed with which this particular unit moved forward should serve as convincing evidence to management that the movement is solidly entrenched. These men certainly must have many concrete grievances to prompt them to act so swiftly.

While the extent and the outcome of the movement are indefinite at present, we can assume that there are some fairly definite causes for the trend. Let us take them up, one at a time.

Firstly, many engineers do not feel that they are being treated as professional men. In certain respects this is inevitable. Mass production methods in industry have required the breakdown of complex operations into simpler ones. Much of the skill has been taken out of the hands of the worker and built into the machine. It might be that this process has finally caught up with the engineer himself; he finds himself entangled in the same web of standardization and simplification that he helped to spin.

A young engineer starting in a large corporation finds himself with a job that has been broken down and standardized. He works on one small segment of the over-all objective of the company. The bulk of the creative engineering is usually carried on by a research engineering laboratory. As a result, he feels that he is divorced from the real engineering that is taking place. He complains that he has no opportunity to put into practice the knowledge and the skills he learned in school.

The significant point seems to be that many engineers feel they have been over-educated for the jobs that are open to them. Few authorities would question the statement that the education of an engineering student today places heavier demands on the individual and covers a far wider field than was the case 25 years ago. The question is—can the young graduate practice what he knows on his job?

Not only do many of these men feel that their jobs do not provide them enough room for really creative effort, they also feel that they have been deprived of some of their status distinc-

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*Mr. Fairchild and Mr. Harrison are instructors in business and economics at Illinois Tech.

CURRENT AND FUTURE RESEARCH AT THE INSTITUTE OF GAS TECHNOLOGY

by ELMORE S. PETTYJOHN*

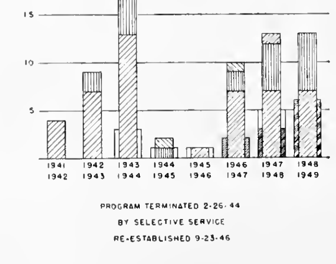
SEVEN and one-half years ago the Institute of Gas Technology began its research and educational functions in behalf of the gas industry. Four years ago the American Gas Association initiated its gas production research program; the Association chose to use the facilities of the Institute, among others. During these four years, the gas production research committee has developed a comprehensive and coordinated plan in which the committee members' background and experience have been joined with the experience and skill of staff members from selected research organizations. This program has been made necessary by the ever-increasing demand for gas for domestic, commercial and industrial purposes, a demand which has required the utilization of every potential source of gas or of gas-making materials, improvement in utilization of existing equipment and the development of new processes having greater flexibility and efficiency.

The Institute of Gas Technology, founded by the gas industry, has provided research facilities and skilled research workers for a major portion of this program. This participation may best be described by a brief review of research projects in progress or in preparation at the Institute. These projects may be grouped under two heads, as either fundamental or applied research, and are supplemented by additional projects financed by Institute funds derived from associate members' dues and from contributions.

*Director of the Institute of Gas Technology at Illinois Tech.

Catalytic Gasification of Propane

The initial research project established at the Institute by the gas production research committee has been a study of the catalytic cracking of propane. This work was begun as a library search in December, 1944, and has progressed through a laboratory study into pilot plant operation. As initially conceived, the study was directed toward the catalytic cracking of propane to a carrier gas consisting largely of carbon monoxide and hydrogen followed by cold enrichment of this carrier gas with additional propane to provide a substitutable, intermediate-gravity, 530 to 540 Btu gas.



The objective was to develop peak-load plants with low investment costs, which would require a minimum of operating labor, could be quickly started and shut-down, and would have no obnoxious waste products requiring high-cost disposal methods. These plants could be located at strategic points in distribution systems, especially in the outlying sections, and could be used to produce and feed back a completely substitutable gas during periods of peak load or emergency. The first of these units was constructed in the fall of 1947 and placed in operation in January, 1948, by the Long Island Lighting company at Riverhead, Long Island. The plant was designed and constructed by the Surface Combustion company and represents a new type of processing plant for the gas industry. Its operation has been very ably described by Mr. S. A. Horsfield in a paper presented to the production conference of the American Gas Association at Asbury Park in June, 1948.

Catalytic Gasification of Hydrocarbons

Anticipating success, the gas production research committee extended the project to include the catalytic gasification of hydrocarbons other than propane or butane. This list has included refinery oil gas, natural gasoline, straight-run and cracked gasolines, light gas oils and more recently natural gas as the raw materials for carrier gas production. These tests have been successful and two plants were placed in operation last Decem-

ber, using natural gasoline as the cracking stock for carrier gas production and using the light ends of this same gasoline for cold enrichment. This type of plant has a lower investment cost due to a substantial reduction in hydrocarbon storage costs and has the same flexibility as the propane cracking plant at Riverhead.

At present, proposals have been submitted to interested gas companies for using straight-run or cracked gasolines as the cracking stock for carrier gas production, with oil gas enrichment made by the thermal cracking of additional gasoline as charging stock to the thermal reforming unit. This approach appears to have distinct possibilities but will require stabilization of the oil gas with the separation of a heavy residue to be used as furnace fuel. The waste disposal problem from this plant will not present a major difficulty; only a small amount of contaminated water will be produced.

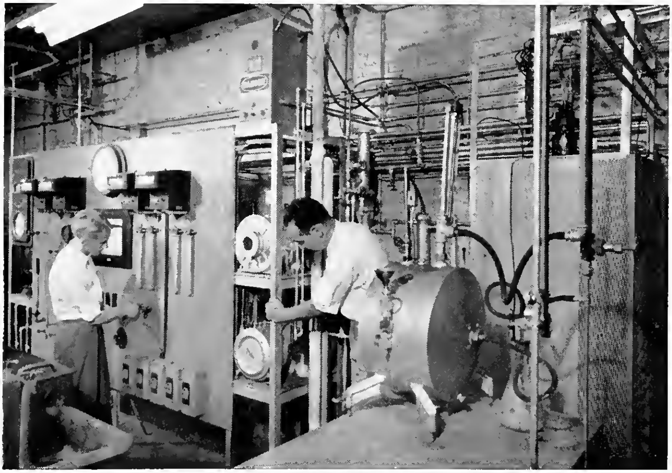
Operating companies along the eastern seaboard are considering the catalytic cracking of natural gas for carrier gas production with natural gas for enrichment to make a base load gas substitutable for the combination of coke-oven gas and carburetted water gas now being distributed. The use of catalytic cracking of natural gas with natural gas enrichment will provide the lowest material, labor and investment costs in natural gas utilization for substitute gas production. The process is a very satisfactory alternative to reforming in the carburetted water gas set and has the advantage of simplicity and lack of nuisance, which will permit location at strategic points in the distribution system. The raw material handling to the plant is accomplished through a single pipeline with flowing gas used directly in the unit, with no storage requirements for either raw material or finished product. This simplification in plant design gives minimum investment costs.

The success of the pilot plant study has brought this project to completion. It is believed that sufficient data have been or can be made available from the pilot plant work at Chester or from the laboratory work at Chicago to enable both plant operators and the vendors of equipment to construct plants of this type and to locate them most effectively.

Study of Catalysts for Gas-Making Reactions

Paralleling, and at times preceding, the work on catalytic gasification has been the study of catalysts for gas-making reactions. This study has been carried forward entirely in the laboratories of the Institute of Gas Technology. Originally conceived to develop sulfur-resistant catalysts, the emphasis was shifted to the catalytic gasification of hydrocarbons using raw materials low in sulfur content. In the initial work with nickel catalysts, it was demonstrated that additions of small amounts of air to steam-hydrocarbon mixtures maintained the resistance of the catalyst to sulfur poisoning. The air minimized or eliminated the deposition of carbon and provided a portion of the heat required for carrier gas production. During this period, preliminary tests were made in the Institute's laboratories on natural gasoline, straight-run and cracked gasolines, treated and untreated kerosenes, and light gas oils with varying concentrations of nickel in the catalysts and with both fire clay refractory and alundum sphere supports. The results of these studies have been reported to the gas industry and additional reports are in preparation.

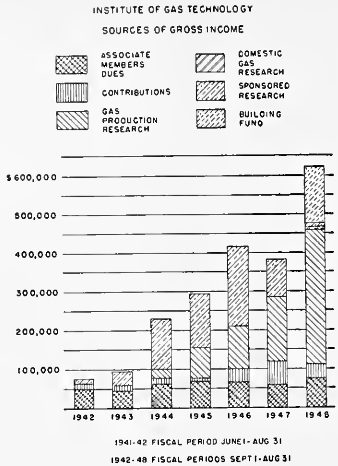
The above tests have established the utility of nickel, as nickel oxide, as a catalyst for the cracking of hydrocarbons from natural gas to cracked gasoline and light gas oils, and has demonstrated the use of air in maintaining uniform operation with constant gas composition and with substantially increased capacities per cubic foot of catalyst volume. These results have led to increases in capacities of existing and proposed cracking plants, which have and will result in substantial reductions in investment costs per unit of daily gas-making capacity. Re-



The pilot unit shown above is capable of simulating the enriching section of a water gas set; of thermally cracking oils in atmospheres of blue gas, hydrogen, or other gases; and of simulating high-Btu oil gas operation. It is used in the study of the enriching value of oils for carburetion.

ductions in investment cost are particularly important for peak load plants where fixed charges are the major item in the cost of gas production.

Research is continuing in an effort to develop catalysts which will gasify charging stocks higher in sulfur content at increased unit capacities and at lower temperatures and higher pressures. Operation at elevated pressure is desirable so that the gas may be distributed under the production pressures, eliminating boosters. Improvements in catalyst supports and the use of promoters will also be studied; and, in addition, preliminary tests will be made on the water gas shift, methanation and organic sulfur conversion reactions.



Fluid Gasification

To extend the use of basic raw materials, a study of the fluid gasification of intermediate and high carbon oils is being prosecuted for the gas production research committee. Calculations were made to determine the application of the Thermofor and the fluid catalytic cracking processes to intermediate and high Btu oil gas production. From these studies a modified fluid gasification unit was designed and approved for construction. As a preliminary, it was necessary to determine whether suitable heat-carrying solids, which would withstand the higher operation temperatures required for gasication, were available. Zirconite, montmorillonite, dehydrated silica gel and coke breeze were all found to be satisfactory as heat transfer media without disintegration or serious attrition at temperatures up to 1950°F. The construction of a pilot unit was approved and the elements have been fabricated. The unit will be erected in Chicago early in 1949 in the new pilot plant at the Crawford avenue station of the Peoples Gas Light and Coke company. Lighter oils will be studied first, followed by residual oils of increasing Conradson carbon content. When 530-540 Btu gas is to be made, it may be necessary to add additional carbon in the form of pulverized coal. If these tests are successful, the amounts of coal added will be increased in an effort to operate with coal as the major source of carbon.

Coal Gasification

For the gas production research committee a further attempt is being made to obtain a lower cost raw material for gas making through a study of coal gasification. In this project, coal is pulverized through the flash pulverizer-cyclonizer system developed at the Institute and then gasified in suspension using oxygen-enriched air and steam. The independent variables studied are the ratios of admitted oxygen and steam to coal, the temperature level and the residence time. The flow of gases in the producer, the method of premixing and admission, the temperature level of the coal-steam-air mixtures in the cyclonizer and while entering the generator, and the temperature of the superheated steam are additional variables, the effects of which are to be evaluated. The results of the initial tests are very encouraging, for gases of 190 to 210 Btu heating value have been obtained with oxygen concentrations of 30 to 70 percent and with carbon gasification in excess of 90 percent of the coal feed. The coal ash has slagged easily, and the amounts of carry over of ash and dust have not been excessive. This process, using low cost, high-ash coal fines as the basic raw material for blue gas or synthesis gas production, is of particular interest to the fuel gas user who requires a clean intermediate heating value gas as a substitute for propane-air where natural gas is now being used on an interruptible basis. These plants have been redesigned so that the conventional gas producer is no longer useful, due to the low-heating value of the producer gas. At present, the process does require oxygen enrichment of the air stream, the amount varying inversely with the superheat in the steam. Preliminary tests have indicated that the additional oxygen may be eliminated if a sufficiently high steam super-heat temperature can be maintained or if substantial amounts of gas are recycled to the furnace to provide the heat for the gas-making reaction.

From the success of the initial tests, the gas production research committee has authorized the design and construction of a larger unit during the current fiscal year to operate at pressures as high as from 75 to 90 pounds. Preliminary plans have been completed and will be submitted for approval shortly. Upon approval the unit and its auxiliaries will be either purchased or fabricated and the unit will be erected in the pilot plant at Crawford avenue.

Fundamental Research in Carbon-Oxygen-Steam Reactions

The basic research being prosecuted for the gas production research committee includes studies of the carbon, oxygen and steam reactions, of the enriching value of oils for carburetion, and of the identification and removal of organic sulfur. The study of the carbon, oxygen and steam reactions is a necessary preliminary to analyses of all gas-making reactions. This study was preceded by calculations of the equilibrium compositions and enthalpy changes in the carbon-oxygen-steam system, which were presented to the industry as IGT Research Bulletin No. 2.

Preliminary laboratory work was done in a small, 4-inch I.D., ceramic, atmospheric-pressure reactor using external heat and a fixed bed. This unit was operated at steady-state conditions with exact measurements made at constant temperature level and distribution in the fuel bed, of air, oxygen and steam flows to the bed and of product gas away from the bed, of the amounts

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BIOLOGY *in Action*

by LESLIE R. HEDRICK*

". . . the study of the largest trees to the smallest plants or of the complexities of protozoa and larger animals, including man . . ."

BIOLOGY, the science of living organisms, encompasses a tremendous scope—in structure, the study of the largest trees to the smallest plants or of the complexities of protozoa and larger animals, including man; in function, an investigation into the methods by which viruses live on their bacterial hosts or of the activity of the human brain. Fundamental studies of the intricacies of plants and animals are responsible for our modern knowledge and use of vitamins, hormones, "weed killers", penicillin, vaccines, hybrid corn, enzymes and plant auxins. In this article we will outline some of the more recent developments in the biological sciences.

The study of any biological group follows a four point pattern: first, gross observations and attempts at classification; second, microscopic study of cellular structure; third, general response to environmental or experimental conditions; and fourth, detailed and carefully controlled studies of the physiology of the organisms, often involving the use of precise and sensitive instruments.

Most of the larger plants and animals, except a few which are located in very remote regions of the world, have been examined and classified. However, only a relatively few of these have been studied in regard to cell structure or physiology. Many smaller organisms have not even been discovered or observed. Some prominent groups of such organisms are: (a) the internal parasites of many animals (most animals are hosts to one or more unwelcome parasites); (b) microorganisms of lakes and streams; (c) microorganisms in invertebrate animals; and (d) microorganisms of the soil.

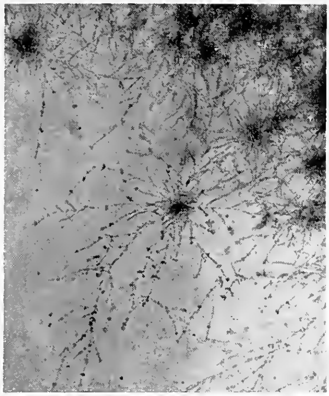
So that we may discuss some of the more recent advances of biology in some detail, we will limit our discourse to three typical examples from the broad general field. The topics chosen are (1) genetics, (2) antibiotics, including penicillin, and (3) physiology and biochemistry.

Genetics. Genetics, the science of inheritance, is practically speaking only

*Professor and chairman of the department of biology at Illinois Tech.

fifty years old. Although some selection and hybridization among domestic plants and animals had been practiced before that time, the general recognition of the laws of heredity occurred in 1900. During that year, three scientists from different countries independently discovered and partially verified the work of Mendel. Gregor Mendel, a Catholic priest, devoted many years of his life to the analysis of the inheritance of garden peas. He published these results in an obscure journal in Brunn, Austria, in 1866. His work slumbered on until 1900, largely because most of the biological scientists were either advocating or denouncing Darwin's theories of organic evolution as presented in his "Origin of Species" in 1859. Mendel died in 1884 unrecognized scientifically, even though Castle said "Mendel had an analytical mind of the first order which enabled him to plan and carry through successfully the most original and instructive series of studies in heredity ever executed" and Bateson added "Untroubled by any itch to make potatoes larger or bread cheaper, he set himself in the quiet of a cloister garden to find out the laws of hybridity, and so struck a mine of truth, inexhaustible in brilliancy and profit". It was soon demonstrated that Mendel's laws of inheritance apply to other plants and animals.

In the United States, Morgan and his students did most of the early fundamental work in animal genetics. They experimented with the fruit or vinegar fly, genus Drosophila. This small fly is easily grown on laboratory media, has a complete life cycle every two to three weeks and supplies abundant mutations for observation. The geneticists with the aid of the cytologists were able to establish the chromosome number (four pairs) and their arrangements in the cells. By very complicated crossing over experiments, when mating flies with different mutations, Bridges and co-workers were able to map the location of the genes (centers for control of inherited characters) upon each of the four pairs of chromosomes. Many additional principles of genetics, over and beyond those discovered by Mendel, have been developed by work on these flies. These



A yeast of the genus candida from the Hawaiian fruitfly. The long thread-like branches are pseudomycelia.

principles, for the most part, apply equally well to other plants and animals. Muller, a recent Nobel prize winner, some twenty years ago demonstrated that the mutation rate in fruitflies could be increased 150 times by the use of x-rays. Since then, x-rays have been used to produce mutations in a variety of living organisms. The fruitfly geneticists are continuing their quest to determine how the gene is able to control the activity of a certain small, but sometimes vital, portion of the insect.

In the meantime plant geneticists were exploring the inheritance mechanisms of wheat, corn, and other plants. In Sweden, Nilssen-Ehle determined the genetics of wheat. As the result of his fundamental studies, other workers were able to develop strains which would better withstand the unfavorable climatic conditions in regions where wheat may be grown and to select and hybridize strains that were more resistant to certain fungus infections, such as rusts and smuts. In America great progress has been made upon the genetics of corn. Some forty years ago G. H. Shull and East proved that when two highly inbred strains of corn were crossed, the resulting plants exhibited "hybrid vigor". These corn plants were taller, more robust, and formed larger ears of corn. No action was taken upon this discovery for 20 to 30 years; then some of the more audacious farmers and seed producers began to apply the information to the production of hybrid seed corn. Within the past 10 years the use of hybrid corn has increased many fold, until now nearly all of the corn grown in the United States comes from hybrid seed corn, with greatly increased yields.

Since 1939 a new segment of genetics has been born: the genetics of microorganisms. At that time Beadle and colleagues at Stanford began their now famous work upon the inheritance of Neurospora, the red bread mold. This organism was selected deliberately in an effort to solve some of the problems in the biochemistry of genetics, the chemistry of gene action. The mutant strains of the mold may be crossed to determine mode of inheritance. Furthermore, the nutrients needed to be supplied in the laboratory media are simply: sugar, inorganic nitrogen salt, other salts, and only one vitamin—biotin. Therefore, all the complex protoplasmic constituents are synthesized by the mold. By the judicious application of ultra-violet light and x-rays, mutants have been produced containing one or more defective genes. Such Neurospora are unable to synthesize, for example, certain required vitamins or amino acids such as riboflavin and leucine, respectively. The strains will only grow if these deficiencies are added to the substrate. Again, hereditary and biochemical principles (such as steps in the synthesis of a protein or vitamin) developed through work with this simple plant are thought to apply to more complex organisms, including man. More recently, other workers have turned their attention to the genetics of yeasts, bacteria and viruses. The viruses seem to be composed for the most part of nucleic acids. It is thought that the gene has a similar composition. Therefore, any worthy discovery in respect to the viruses may cast some light upon the activity of the gene.

Antibiotics. The general subject of antibiotics, for practical purposes, is only 10 years old. The term is derived, of course, from the Greek, *anti*, against and *bios*, life. Although many bacteriologists had casually noticed that some

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A Year of Research

AT ARMOUR RESEARCH FOUNDATION OF ILLINOIS INSTITUTE OF TECHNOLOGY

"There is no technological crystal ball guaranteed to reveal the economic future, but both industry and government are turning more and more to science as one key to a brighter, healthier world. The search for better, newer methods and ideas in industry is our business, and we believe that search to be a real public service."

Thus Dr. Haldon A. Leedy, director of Armour Research Foundation of Illinois Institute of Technology, introduced the 1947-1948 annual report of the Foundation. Excerpts from the report are published below.

FAVORED by the progressive research attitude of its sponsors, and implemented by the improved and enlarged research power of its staff and facilities. Armour Research Foundation of Illinois Institute of Technology has completed its most successful year of service to industry and government. For the twelfth consecutive year, it has maintained a record of continuing growth. Success and growth may be measured in several terms, but Armour Research Foundation takes greatest pride and satisfaction in the increasing size and competence of its technical staff, its improved equipment, the improved quality and growing total volume of its research output, and the continued confidence of its sponsors, as witnessed by the increasing percentage of new and renewed research projects from former sponsors.

It is an accepted obligation that size and strength entail large responsibility. Humbly aware that its services are not perfect, the Foundation has accomplished much during the past year in improving the quality of its research, with emphasis on better internal organization, careful attention to basic policies, stimulation and advancement of technical staff through internally conducted fundamental research projects, fostering staff education and professional activities, and recruiting of expert staff.

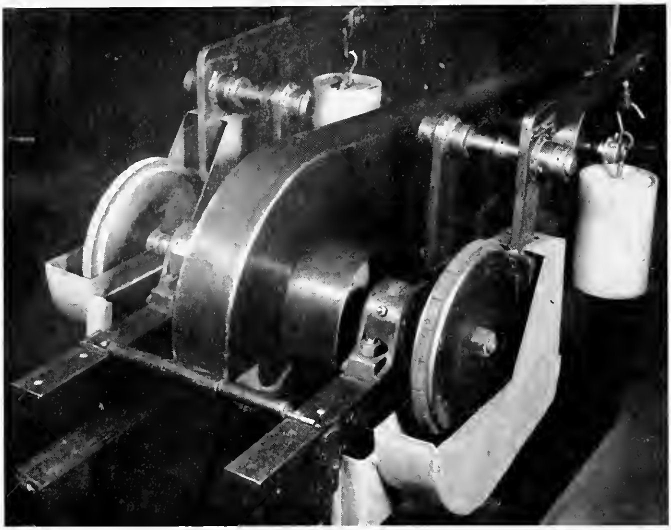
Responsibilities to the public have been served by absorbing a constantly increasing load of government research, by donating several research projects to the local public benefit on problems such as dust and noise abatement, and by giving assistance to medical research. Furthermore, the Foundation has sponsored five symposia or conferences of ultimate value to the public on broad technical subjects. Two hundred of its staff have served as members, officers and committee members in various scientific and technical societies. About 100 articles have been published in technical journals, thus increasing the public stock-pile of basic scientific knowledge.

Dr. Haldon A. Leedy was named director of the Foundation in 1948. He had been chairman of physics research since 1944 and a member of the staff since 1938.

Through its International Division, the Foundation has assisted Mexico, Central and South America, and other countries in developing their natural resources, in improving their industries and their living conditions, and in establishing their own research institutes. In this way it has materially contributed to the "good neighbor" policy.

During the past year more than 110 industrial organizations and 20 governmental agencies have carried on research programs at Armour Research Foundation. The Foundation's staff was increased by about 150, or approximately 30 per cent, to a present total of about 640. Gross volume of research for the year was about \$3,380,000, approximately 25 per cent larger than the previous year. A total of 191 research projects were in progress during the year, and operating expenses as a percentage of volume have actually been reduced.

As an indication of the prestige and recognition which Armour Research Foundation has achieved, administrators and industrial executives from all parts of the country, as well as from many foreign countries, have visited the Foundation to study our plan of organization and our methods of conducting industrial research. In turn, the Foundation leaves no possible avenue unexplored whereby it can broaden and improve the quality of its services, rendered at cost, to its sponsors. For the coming year, still further expansion and improvement of facilities and staff are planned to keep pace with the rapid increase in fundamental and



The Foundation's laboratory abrasion testing machine. Note toothed rubber wheels on both sides of the machine enabling two tests to be run at the same time.

applied research which is so essential to industrial growth, social health and national security.

RESEARCH DIVISION

Applied Mechanics Research

Efficient functioning of the large Applied Mechanics department was assured this year through reorganization and establishment of general operating procedures. More than 100 staff members comprise six well-defined but closely coordinated sections: structural mechanics, mechanisms, fluid mechanics, materials engineering, mechanics instrumentation, and propulsion. A special analysis group is available for complex analytical and theoretical problems. Closely affiliated with mechanics activities at Illinois Institute of Technology, the department retains the over-all flexibility necessary for future growth.

An urgent need for additional office and laboratory space required that much of the department's activities be moved to new and consolidated quarters. At the end of the fiscal year this major move was being arranged.

Ceramics and Minerals Research

The entrance of the Ceramics and Minerals department into stratigraphic research directed toward the location of new oil fields, along with plans for future research for a number of trade associations and the refractory industry, reflect the progress of this department.

A newly constructed slag viscometer, a sea water evaporator, and two high-temperature electric furnaces capable of attaining temperatures in excess of 2000°C are a few of the items of major equipment added during the year. Additional office space was gained by the department which operated in four sections: ceramics, masonry materials, minerals, and inorganic chemistry. Modern statistical techniques were used in a number of projects. All of the major branches of ceramics and related fields are represented in current projects which occupy this department. Added to this diversity of activity was considerable work done in cooperation with other research departments, particularly metals and applied mechanics.

Chemistry and Chemical Engineering Research

A large portion of the industrial research activity of this country is in the chemical field, and the department of chemistry and chemical engineering experienced an important and rapid expansion during the year. An increase in the total departmental staff of 21, a net increase of 14 additional research projects, and the acquisition of more than 40 pieces of scientific equipment all indicate this general growth.

Special services maintained by the department include dust analysis, collection of crystal data, and the National Registry of Rare Chemicals. Plans for new and fruitful research in chemistry have been made. These include the study of retting and retting of ramie, electrets, low cast molded fiber furniture, chemical milling of wheat, and optical bleaches.

Electrical Engineering Research

During the year the electrical engineering department increased its volume of research, the size of its staff, and its laboratory facilities. Somewhat more laboratory space for electronics work was gained, five technically qualified persons were added to the staff, and a large number of instruments were purchased to round out the present laboratory facilities.

Of considerable value in projects requiring precision electrical measurements, the Ohmite Laboratory began its third year of service to industry and of aid to graduate study. Both functions of this laboratory are expected to increase appreciably. Where assistance has been required in electrical engineering phases of research problems, this group has contributed to the successful efforts of other departments throughout the year.

Metals Research

Installation of large new transformers and bus bars for 440 volt, three phase power in the Metals building now makes possible the operation of large welding and industrial heat treating equipment enabling the metals research department to expand its services to industry and government. Enlargement and improvement of the electrochemistry and metallographic laboratories also were important changes.

This department now has well equipped metal processing, heat treating, welding and foundry laboratories, the latter including excellent melting and casting facilities. The entire Foundation is assisted by a consult-

(Please turn to page 18)

BURIED ALIVE

Aerial cable gets protective wrapping before going underground.

A highway near Ann Arbor, Michigan, was being widened. This meant that a telephone pole line had to come down. But the cables it carried were too busy and too important to be cut. They had to remain in constant use.

Telephone engineers got busy.

Within two months, cables along the five mile stretch were "buried alive"—with every circuit in service all the time. Every inch of cable was given a protective wrapping to make it suitable for underground use. Streets, highways and railroad tracks were crossed. Work was done at night to avoid busy-hour traffic. Yet not a single telephone call was interrupted.

The skill and initiative of the telephone engineer are important reasons why America has the finest telephone service in the world—at the lowest possible cost.

BELL TELEPHONE SYSTEM

Instrumentation for field calibration of accelerometers. Study of acceleration—the time rate of change of velocity—will advance the improvement in riding comfort and performance of vehicles and in the design and installation of high-speed machinery. It will also tell us more about the behavior of structures and soils under dynamic loading, Foundation scientists say.

(Continued from page 16)

ing service on metals selection, fabrication, and processing.

Metals research experienced a healthy growth of activities during the year and a large increase in research volume. New research studies in abrasion and in extraction metallurgy were highpoints of the year.

Physics Research

The technical staff of the department of physics has been strengthened, especially in the fields of nuclear physics and physics of the solid state. Establishment of more complete liaison with the Magnetic Recorder division, acquisition of the Foundation's high pressure laboratory, and the addition of significant research facilities, including a new electron diffraction unit, also were important events of the year. The research volume increased considerably.

Much of the success of many scientific meetings was due to the energetic professional attitude of the department of physics staff members, who were responsible for an impressive list of articles and papers published and lectures delivered. Special services of the department included work in color, high-speed, and three-dimensional photography, optical systems design, illumination engineering, spectrographic analysis, and operation of the Riverbank Acoustical Labroatories.

INTERNATIONAL DIVISION

Although this report marks the seventh year since the Foundation entered the specialized field of international service, the International division, as such, has just completed its first full year of operation. The division was formally established early in 1947. In both form and function, the International division is believed

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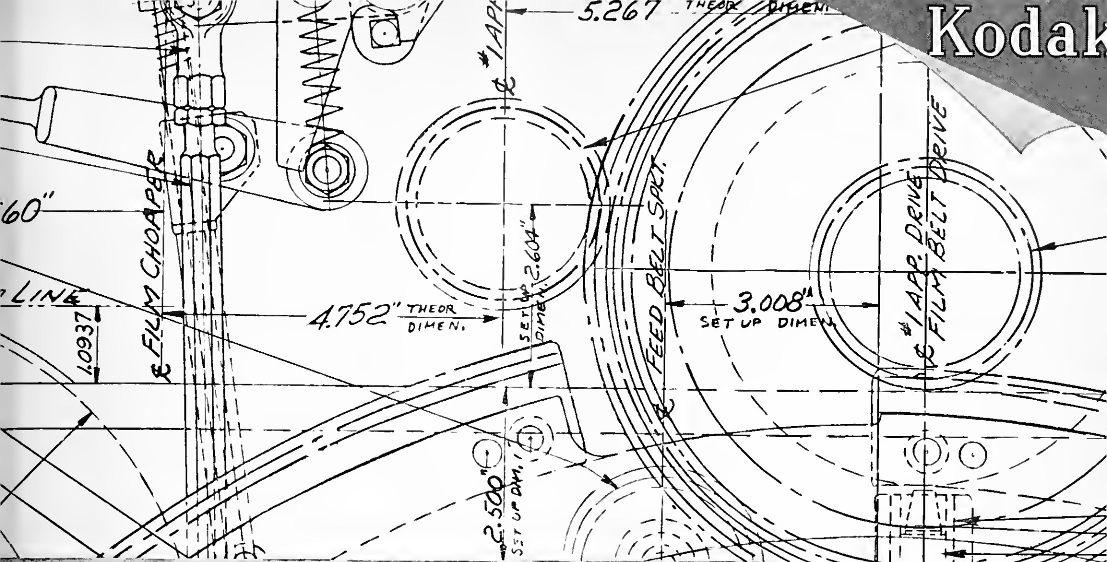
Kodak



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Advancing industrial technics—Functional Photography

(Continued from page 18)

to be the only organization of its kind in existence.

Starting from the premise that it is economically as well as morally sound to do everything possible to raise the standards of living, health, and education of people in other countries of the world, and to develop their resources, industries, and agriculture as the only conceivable means toward better balanced trade and economic operation, it has been recognized that among under-developed nations the really basic common denominator is lack of technology. Armour Research Foundation, therefore, has undertaken to provide for these countries the same impartial, non-profit, non-political industrial research service that is available to the United States, and that is such an important key to the continued progress of this country.

Contribution of the Foundation, through its International division, already has been demonstrated in the creation of new sources of much-needed dollar exchange, discovery of undeveloped natural resources, selection of sound versus unsound new industries, encouragement of both foreign and domestic capital investment, the training of technical men, and the establishment of applied research facilities in the countries where such work has been done.

A summary of the most significant international work of the Foundation follows:

Argentina

Complete studies include: (1) Argentine Economic Structure, (2) Analyses of selected industries, (3) technology in Argentina, and, (4) a proposed Argentine Research Institute.

All these investigations were made for the Corporacion para la Promocion del Intercambio—under the Banco Central de la Republica Argentina—and have been widely published through these organizations both in Spanish and English. The recommendations have resulted in numerous specific advances and establishment of new factories and facilities, with additions each year.

Experimental model of the endless belt magnetic recorder developed by the Magnetic Recording division. The record is a wide endless belt of paper coated with magnetizable material and can be folded to envelope size. The invisible magnetic track follow a helical path around the belt. The record can be erased for correction or re-use.

Mexico

The extensive program of the Foundation in Mexico has been underway since 1944. Studies already completed include: (1) special factors in Mexican industrial development, (2) solid fuels, (3) hides and leather, (4) fibers, (5) forest products, (6) applied technology in Mexico, and, (7) a proposed Mexican Research Institute.

At the present moment all of these studies are being published in Spanish by the Banco de Mexico, S. A., which sponsored the work. They have appeared in English under the general title "Technological Audit of Selected Mexican Industries."

Also completed but unpublished are the confidential solutions of problems in the commercial extraction and concentration of cascalote tannin, productive analysis and extraction of quinine and other anti-malarials from Mexican cinchona trees, improvement of Monterrey glass manufacture, and improvement in the henequen industry. To make the last named study, the Foundation staffed and operated the Merida laboratory of the associated "Henequeneros de Yucatan" for a

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(Continued from page 20)

year, with the support of the Banco de Mexico. As a projection of this work, at the request of the President of Mexico a plan has been drawn for the general economic development of the entire Yucatan peninsula, including especially the greater production of necessary food crops.

At the beginning of the fiscal year the Foundation established research facilities in Mexico City in order to speed the work on several research projects for the Banco de Mexico. This additional physical plant includes three ample and well-equipped chemical laboratories, a small milling laboratory, a complete spray-drying pilot plant, a workshop, a library, several auxiliary rooms, and an office. It is interesting to note that these facilities were installed and in full operation 30 days after original conception. Staffed with combined U. S. and Mexican technical personnel, and operated in conjunction with field work throughout the Republic, the laboratories have proved unusually productive.

Two precision bridges for precise measurement of electrical resistance in the Foundation's Ohmite laboratory. A six-dial Wheatstone bridge is shown in the left foreground, a five-dial Kelvin bridge in the center foreground.

Among the projects conducted in the Mexican laboratories during the year and still in progress are: (1) investigation of sources, extraction, and properties of 15 fixed oils native to Mexico, several of which have already shown themselves to be excellent drying oils for the paint industry; (2) extraction and utilization of additional Mexican tannins; (3) recovery of by-products of the meat packing industry;

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DU PONT Digest

For Students of Science and Engineering

C. M. Olson, *Ph.D.Phys.Ch., Chicago '36, and C. H. Winter, Jr., B.S.Ch.E., Virginia Polytechnic Institute '40, removing 100-lb. titanium ingot from furnace in heat-treating study.*

PRODUCING METALLIC TITANIUM FOR INDUSTRIAL EVALUATION

Du Pont group research developed a pilot plant with daily capacity of 100 pounds

Du Pont research has just made available to industry what may become one of America's key structural materials, titanium metal. Midway in density between aluminum and iron and with an especially high melting point, silvery-white titanium offers an extraordinary combination of strength, lightness, corrosion resistance and hardness.

Titanium is the ninth most common element. But it has been slow in coming into its own as a metal because of the difficulty of separating it in pure form from its ores.

Men pictured *on this page were members of titanium research team. E. L. Anderson, A.B.Ch., Brigham Young '40; J. B. Sutton, Ph.D.Phys.Ch., West Virginia '35; A. R. Conklin, M.S.Phys.Ch., Georgia '40, are shown inspecting 300 lbs. of Du Pont titanium metal sponge.*

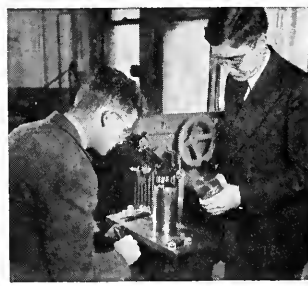
Du Pont scientists first began to probe the possibilities of metallic titanium in the course of their long experience with the titanium oxide pigments. Their research was interrupted by World War II. Meanwhile, the U.S. Bureau of Mines laboratories succeeded in producing the metal for research purposes.

After the war, Du Pont scientists developed a process for the production of ductile titanium metal that can be scaled up to meet commercial demands. The research team that mastered the complex problem consisted of chemical engineers specializing in design and production, as well as chemists and a metallurgist. In September 1948, a pilot plant was opened with a daily capacity of 100 pounds. Titanium metal is now being produced in sponge and ingot form. Samples are available to industrial and college laboratories with research projects in related fields. Studies of methods for forming, machining and alloying are under way.

Exhaustive studies will be necessary before the many possibilities of titanium metal can be known. Because of its high ratio of strength to weight, early uses may be in airplane power plants and structural parts. Its hardness and rust-resistance recommend it for railroad transportation equipment, marine power plants and propellers, and food packaging equipment. Its high melting point suggests use in pistons, and its resistance to electric currents points to electronics. Titanium wire may be used for springs and titanium sheet for such highly stressed parts as microphone diaphragms.

Your Opportunity in Research

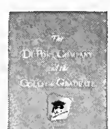
The commercial development of titanium metal is a typical example of Du Pont research in action. However, the Pigments Department, which worked out the process, is but one of the ten Du Pont manufacturing departments. Each conducts continuous research. Each is operated much like a separate company. Within these "companies"—whose interests range from heavy chemicals to plastics and textile fibers—college trained men and women work in congenial groups where they have every opportunity to display individual talent and capabilities. Who knows what their contributions will mean in the future to science and the world!



R. C. Reidinger, *B.S.Ch.E., Princeton '47, and T. D. McKinley, B.S.Ch., Worcester Polytechnic Institute '35, making a test of the hardness of ingots of Du Pont titanium metal.*

THIS BOOKLET WILL HELP YOU

PLAN YOUR CAREER



Send for your personal copy of "The Du Pont Company and the College Graduate" Describes opportunities for men and women with many types of training. Explains how individual ability is recognized and rewarded under the group system of operation. Address: 2518 Nemours Building, Wilmington, Delaware.

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WRITE TODAY *for "The Du Pont Company and the College Graduate"*

(Continued from page 22)

and, (4) development of the extensive high-grade Mexican fluorspar deposits.

Two especially significant pieces of research have been completed in these laboratories in the past year and in both cases the products are now in the pilot-plant stage preparatory to large scale manufacture. One of these products, already widely noted in the world's press, is a new, high-melting industrial wax from henequen waste, which is conservatively estimated to mean at least $20,000,000 in annual exports. The other is a stable dry flour for making tortillas, the basic Mexican diet item heretofore, and since the days of the Aztecs, made only from freshly-ground wet corn. In addition to its production economies, this is the first dry flour to yield a tortilla completely acceptable to the Mexican public. Through its help in solving certain fundamental problems of distribution and conservation of food supply, this development is expected to have an appreciable effect upon national nutrition and industrial productivity.

Haiti

As the new fiscal year begins, the Foundation is completing preparations for a general research and development program at La Plantation Dauphin, Cape Hataiian, Haiti. This project will deal chiefly with agave sisalana (sisal) and possibly other crops suitable to the area. Its objective will be greater economy and improved products in the already modern operation of this plantation.

Puerto Rico

Simultaneously with the Haitian project, arrangements have been made to begin research on the improved processing and utilization of coir fiber for the Puerto Rico Fiber corporation. This work will be conducted both in Puerto Rico and in the Chicago laboratories of the Foundation.

MAGNETIC RECORDER DIVISION

Two major developments and a notable advancement on a third development made previously marked the 1947-48 fiscal year for the Magnetic Recording division. The developments were: stereophonic sound and the endless belt magnetic recorder. The advancement mentioned concerns magnetic sound on film, and was achieved when sound was successfully recorded on 8 mm film. The division's scientists had previously been successful in similar experiments on both 16 and 35 mm film.

Magnetic Sound on 8 mm Motion Picture Film

Although magnetic sound on motion picture film was announced some

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time ago, this concerned chiefly 35 and 16 mm film. It is several times more difficult to put sound on 8 mm film than on 35 mm, and some six to seven times more difficult than on 16 mm. Experiments previous to the start of the fiscal year on 8 mm film met some success, but the process was not completed until this year.

Research during the year included work toward improving the record media. Considerable improvement in both wire and tape was made. Much research and development also was done on magnetic recording equipment for commercial use, such as computing machines and automatic lathes. Work along these lines is continuing with important disclosures expected in the not-too-distant future.

Endless Belt Magnetic Recorder

The machine with this new-type medium was announced early this year. The record in this machine is a wide, endless belt made of paper and coated with a thin layer of magnetizable material. An invisible magnetic track follows a helical path around the belt. A belt which will fold to the standard 8½ inches by 11 inches size will take approximately 45 minutes of dictation while business envelope size belts will record for 15 minutes and correspondence envelope size belts will record up to 10 minutes. The magnetic head may be lifted and set down on any part of the belt by means of an index knob. A removable scale on the front of the experimental machine is graduated in minutes and has space for pencil notes. For repeating or backspacing, a relay can move the head back automatically for a line or two or the pickup head can be moved manually.

The erase feature, common to all magnetic recording equipment, makes it unnecessary to keep a record of errors since errors can be wiped out at any time and the corrections recorded in their stead. Folding does not harm the magnetic track and for routine dictation the record can be used thousands of times, either for playbacks or by erasing the record and reusing.

Stereophonic Sound

The development of stereophonic sound (three-dimensional sound) marked the end of numerous experiments by recording experts throughout the world over a period of years. Scientists have endeavored, almost since sound was first recorded and played back, to record on several sound tracks simultaneously and play back in synchronization, thus avoiding the point source of playback and giving width, height and depth to the playback—the same width, height, and depth which were present in the original sound.

Several sound tracks are recorded on a single width of tape. With microphones strategically placed throughout the area of the record source, recordings can be made of the various portions of the total sound without concern for synchronization. On playback the microphones are replaced by loud speakers, enabling the recorded signal to be played back in perfect synchronization from several sources, thereby simulating live conditions.

11th Annual

MIDWEST POWER CONFERENCE

—APRIL 18-19-20, 1949—

The Eleventh Annual Midwest Power Conference, sponsored by Illincis Institute of Technology with the cooperation of 18 midwestern colleges and universities and local and naticnal societies, will be held April 18, 19, and 20 at the Sherman Hotel, Chicago.

R. A. Budenholzer, professor of mechanical engineering at Illinois Tech, is conference director. During the past year he succeeded Stanton E. Winston, dean of the evening division and professor of mechanical engineering, who had served as director since 1940.

Largest of its kind in the world, the conference annually attracts more than 2,500 engineers from all over the nation in the field of power production, transmission, and consumption.

The preliminary program for 1949 follows:

Monday, April 18, 1949

8:30 A.M. Registration, Sherman Hotel.

10:00 A.M. Opening Meeting. Chairman: Alex D. Bailey, Vice President, Commonwealth Edison Co., Chicago.

(a) Address of Welcome. Ben G. Elliott, Chairman, Department of Mechanical Engineering, University of Wisconsin.

(b) Can Socialism Produce for the U.S.?, J. W. Mc Afee, President, Edison Assn. of Illuminating Companies.

(c) Electric Power Supply and National Security. Edward Falck, Director, Utilities Branch, National Security Resources Board, Washington, D. C.

12:15 P.M. Joint luncheon with A.S.M.E. Chairman: W. H. Oldacre, Chairman, Chicago Section A.S.M.E.
Speaker: Arrangements Pending.

2:00 P.M. Modern Steam Generators.* Chairman: R. B. Gutekunst, Chairman, Power and Fuels Division, Chicago Section, A.S.M.E.
(Sponsored and arranged by Power and Fuels Division, Chicago Section, A.S.M.E.)

(a) Evolution of Today's Central Station Boiler. E. M. Powell, Design Engineer, Combustion Engineering Superheater, Inc., New York.

(b) Present Developments in Boiler Design. Frank X. Gilg, Application Engineer, The Babcock and Wilcox Co., New York.

2:00 P.M. Power System Planning. Chairman: E. W. Kimbark, Northwestern University.

(a) Economic Factors in Transformer Application. L. LeVesconte, Sargent & Lundy, Chicago.

(b) Cost of Supplying Electrical Losses. Paul H. Jeynes, Public Service Electric and Gas Co., Newark, New Jersey.

3:30 P.M. Feedwater Treatment No. 1. Chairman: M. P. Cleghorn, Iowa State College.

(a) Feedwater Treatment for the 100 Percent Makeup 1500 psi boilers at Whiting, Inidana. Glen Hull, General Foreman, Utilities Division, Standard Oil Co. of Indiana, Whiting Indiana.

(b) Feedwater Conditioning at the Steel Co. of Canada, Ltd. A. C. Elliott, Asst. Combustion Engineer, The Steel Company of Canada Ltd., Hamilton, Canada.

3:30 P.M. Network Analyzers and Analog Computers. Chairman: E. B. Kurtz, State University of Iowa.

(a) A 10,000 cycles Network Analyzer. W. B. Boast and J. D. Ryder, Professors of Electrical Engineering, Iowa State College.

(b) The Anacom, The Analog Computer, Applied to Mechanical and Electrical Problems in Power Systems. D. L. Whitehead, Central Station Engineer, Westinghouse Electric Corp., East Pittsburgh, Pa.

Tuesday, April 19, 1949

9:00 A.M. Small Power Plants. Chairman: Clifton R. Harding, President National Association of Power Engineers.
(Sponsored and Arranged by the N.A.P.E.)

(a) Design of Small Industrial Power Plants, Parker Moe, Consulting Engineer, Gates, Moe, Weiss & Tatentheim, Consulting Engineers, Milwaukee Wisconsin.

(b) What Can A Small Plant Do About Fly Ash? Carl E. Miller, Technical Advisor, Battelle Memorial Institute, Columbus, Ohio.

9:00 A.M. Control Characteristics of Industrial Processes. Chairman: K. W. Miller, Armour Research Foundation of Illinois Institute of Technology.

(a) Significance of the Process in Problems of Thermal and Flow Regulation. Albert F. Sperry, President, Panellit Inc., Chicago.

(b) Significance of Controller Dynamics in Electro-Mechanical Systems. Richard W. Jones, Associate Professor of Electrical Engineering, Northwestern Technological Institute.

10:30 A.M. General Session. Chairman: W. A. Lewis, Illinois Institute of Technology.

(a) Power Supply and Requirements in the United States. E. R. de Luccia, Chief, Bureau of Power, Federal Power Commission, Washington, D. C.

(b) Present Status of Atomic Power. Dr. Norman Hilberry, Deputy Director, Argonne National Laboratory, Chicago.

12:15 P.M. Joint luncheon with A.I.E.E. Chairman: F. D. Troxel, Chairman, Chicago Section, A.I.E.E.
Speaker: T. G. LeClair, Assistant Chief Electrical Engineer, Commonwealth Edison Co. Chicago. "Power Supply For A Large Metropolitan Area."

2:00 P.M. Central Station Equipment. Chairman: Ben G. Elliott, University of Wisconsin.

(a) Suction Intake Design For Vertical Circulating Pumps. W. Wiltmer, Engineer, Centrifugal Pump Dept., Allis Chalmers Manufacturing Co., Milwaukee, Wisconsin.

(b) Recent Developments in the Design of High Pressure, High Temperature Steam Turbines. C. W. Elston, Division Engineer, Steam Turbine Engineering Division, General Electric Co., Schenectady, N. Y.

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*A short discussion is included at the end of each technical session.

(Continued from page 28)

2:00 P.M. Feedwater Treatment No. 2. Chairman: L. G. Miller, Michigan State College.

(a) Water Treatment For the High Pressure Plant. Louis Wirth, Jr., Supervisor, Power Division Laboratory, The Dow Chemical Co., Midland, Michigan.

(b) Removal of Silica From Boiler Feedwater by the Sludge Blanket Hot Process Softner and Exchange Methods. J. D. Yoder, Vice President, The Permutit Co., New York.

3:30 P.M. Distribution Systems. Chairman: E. T. B. Gross, Chairman, Power Group, Chicago Section, A.I.E.E.

(Sponsored and arranged by Power Group Chicago Section, A.I.E.E.)

(a) Resonant Grounding of Distribution Systems. E. Herzog, Electrical Engineer, Army Air Forces, Wright Patterson Air Base, Dayton, Ohio.

(b) A 33 kv Inter-Connected Sub Transmission System with the Development and Operation of 4 kw Networks. William R. Waugh, Relay Engineer, Indianapolis Power and Light Co., Indianapolis, Ind.

3:30 P.M. Central Station Operation. Chairman: N. A. Parker, University of Illinois.

(a) Evaluation and Location of the Losses in a 60,000 kw Power Station. C. Birnie, Jr., and E. F. Obert, Northwestern Technological Institute, Evanston, Ill.

(b) Purification of Water by Compression Distillation. E. T. Erickson, Erickson Chemical Co., Chicago.

3:30 P.M. Maintenance Problems of Small Plants. Chairman: J. W. Andeen, University of Minnesota.

(a) Preventive Maintenance Program For Small Plants. Leland J. Mamer, Chief Engineer, Evanston Hospital, Evanston, Ill.

(b) Maintenance of Package Boilers. F. W. Hainer, Vice President, Clever-Brooks Co., Milwaukee, Wisconsin.

6:45 P.M. "All Engineers" Dinner. Informal. Grand Ball Room. (Ladies Invited).

Wednesday, April 20, 1949

9:00 A.M. Heating and Air Conditioning. Chairman: William Goodman, Illinois Institute of Technology.

(a) Room Air Distribution in Year Round Air Conditioning. G. L. Tuve, Head, Department of Mechanical Engineering, Case Institute of Technology, Cleveland, Ohio.

(b) Transmission of Heat by a Fluid Carrier. Samuel R. Lewis, Samuel R. Lewis and Associates, Chicago.

9:00 A.M. Electricity in Farm Industry Comes of Age. Chairman: D. D. Ewing, Purdue University.

(a) Electrifying Farm Productive Equipment. J. H. Oliver, In Charge, Product Development, Farm Industry Division, General Electric Co., Schenectady, N. Y.

(b) Providing Adequate service on Rural Power Systems. R. F. Quinn, Manager, Line Apparatus Equipment,

Agency Division, General Electric Co., Schenectady, N. Y.

9:00 A.M. Symposium on Steam Contamination. Chairman: R. T. Hanlon, National Aluminate Corporation, Chicago.

(a) Carryover Types and the Effect of Design of Drum Internals Upon Steam Contamination. P. B. Place, Combustion Engineering-Superheater, Inc., Chattanooga, Tenn.

(b) The Problem of Silica Carryover in Boiler Steam, and of Turbine Blade Deposits. F. G. Straub, Research Professor of Chemical Engineering, University of Illinois, Urbana, Ill.

(c) Steam Contamination Experience on the American Gas and Electric Company's System. W. L. Webb, Mechanical Engineering Division, American Gas and Electric Service Corp., New York.

(d) High Speed Motion Picture Study of Steam Formation Phenomena. L. O. Gunderson and C. M. Bodach, Dearborn Chemical Co., Chicago.

(e) Diagnosis of Carryover Problems by Proper Plant Test Procedures. J. A. Holmes Assistant Vice President, National Aluminate Corporation, Chicago.

10:30 A.M. The Heat Pump. Chairman: C. M. Burnam, Jr., President, Illinois Chapter, American Society of Heating and Ventilating Engineers.

(a) Some Aspects of the Soil Problem in Connection with Heat Pump Buried Coil Design. Donald M. Vestal, Jr., Project Supervisor, Reverse Cycle Heating Project, Texas A. & M. Research Foundation, College Station, Texas.

(b) Controlling the Heat Pump. F. R. Ellenberger, Remote Equipment Engineering Division, Air Conditioning Department, General Electric Co., Bloomfield, N. J.

10:30 A.M. Industrial Applications. Chairman, T. A. Abbott, Chairman, Industrial Group, Chicago Section, A.I.E.E.

(Sponsored and Arranged by Industrial Group, Chicago Section, A.I.E.E.)

(a) Developments in Industrial Distribution Systems. H. B. Thacker, Central Station Engineer, Westinghouse Electric Corp., East Pittsburgh, Pa.

(b) Distribution Problems Caused by Resistance Welding Loads. H. Watson Tietze, Senior Engineer, Electric Distribution Dept., Public Service Electric and Gas Co., Newark, N. J.

10:30 A.M. Symposium on Steam Contamination. Cont'd.

12:15 P.M. Joint luncheon with W.S.E. Chairman: L. E. Grinter, Chairman, Civic Committee, Western Society of Engineers.

(Sponsored and Arranged by Civic Committee of W.S.E.)

Speaker: R. A. Stipes, Jr., President, Illinois Chamber of Commerce. "Engineers Can Influence Civic Affairs."

2:00 P.M. Feedwater Treatment No. 3. Chairman: R. C. Porter, University of Michigan.

(a) Problems Encountered in the Treatment of Cooling Tower Water For the Prevention of Incrustation and Corrosion. E. C. Hosbach, Power Engineer, The Texas Co., Lockport, Ill.

(b) Problems in the Treatment of Cooling Water in Industrial Plants. L. D. Betz, General Manager, W. H. & L. D. Betz, Chemical Engineers, Philadelphia, Pa.

2:00 P.M. Diesel Power. Chairman: W. P. Green, Illinois Institute of Technology.

(a) Two Cycle Dual Fuel Engines. L. D. Thompson, Superintendent, Experimental Division, Fairbanks Morse & Co., Beloit, Wis.

(b) Dual Fuel Engine Design. George Stevens, Executive Engineer Worthington Pump and Machinery Co., Buffalo, N. Y.

(c) Dual Fuel Engine Performance and Economics. Ralph L. Boyer, Vice President and Chief Engineer, The Cooper-Bessemer Corp., Mt. Vernon, Ohio.

2:00 P.M. Electric Sales. Chairman: R. G. Raymond, General Sales Manager, Commonwealth Edison Co., Chicago.

(a) Television. Fred Compton, General Sales Manager, Detroit Edison Co., Detroit, Michigan.

(b) Promotional Sales Plan for 1949 of The Commercial Section of the Edison Electric Institute. Harry Restofski, General Sales Manager, West Penn Power Co., Pittsburgh, Pa.

3:30 P.M. Gas Turbines. Chairman: J. T. Rettaliata, Illinois Institute of Technology.

(a) Some of the Problems Involved in the Coal Burning Gas Turbine Locomotive. C. K. Steins, Mechanical Engineer, Pennsylvania Railroad.

(b) Design of a Locomotive Gas Turbine. W. B. Tucker, Turbo-Power Development, Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

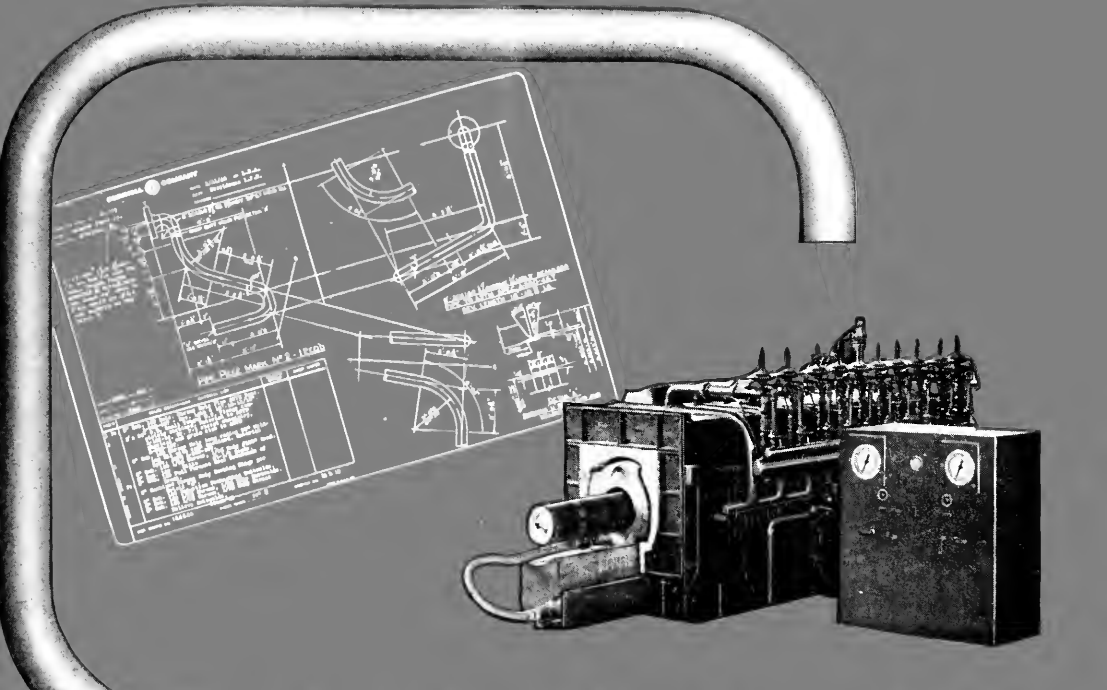
(c) Water Spray Injection of an Axial Flow Compressor. I. T. Wetzel, Lecturer in Mechanical Engineering and B. H. Jennings, Professor and Chairman of the Department of Mechanical Engineering, Northwestern Technological Institute.

3:30 P.M. Electronic Appliances. Chairman: A. H. Wing, Chairman, Electronics Group, Chicago Section, A.I.E.E.

(Sponsored and arranged by Electronics Group, Chicago Section, A.I.E.E.)

(a) Electronics in the Public Utilities Field. W. M. Kiefer, Commonwealth Edison Co., Chicago.

(b) Electronics in Industry. G. M. Chute, Application Engineer, General Electric Co., Detroit, Mich.



Keeping stainless steel STAINLESS

. . . a typical problem in fabricating alloy piping

Heat a piece of stainless steel pipe to bend it and right away you're up to your ears in metallurgical complications. To begin with, stainless steel isn't just one alloy. There are hundreds of different types of stainless steel, each selected for its resistance to corrosion or its stability at high temperatures. To maintain the metallurgical properties which dictate the choice of a particular alloy steel, you have to know the temperature range within which this steel may suffer excessive metallurgical changes. And you have to have specialized equipment to maintain the precise control necessary to avoid these hazards.

Grinnell pipe fabrication equipment includes specially designed gas-fired radiant heat furnaces for this precisely controlled heat treatment of stainless steels and other alloy steels. Multiple burners are strategically located to distribute temperature uniformly and to prevent harmful flame impingement. Precision instruments regulate temperature and time.

It's an intricate business . . . fabricating alloy steel piping. It's a job for Grinnell prefabricating plants because Grinnell has the equipment and modern methods, the interpretive engineering, the metallurgical research facilities and the skilled personnel.

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ENGINEERING GRADUATES HAVE FOUND ATTRACTIVE OPPORTUNITIES WITH GRINNELL.

Over the River to Grandma's House, by *Grandma Moses. Copyright by Galerie St. Etienne, 46 West 57th street, New York City.*

...Grandma Moses

(Continued from page 8)
homeland. But just at that moment the little ten-year-old Jennie pinched my arm and whispered: "Oh, I can see that is a wonderful picture, but the others over there on the piano—if I had painted such a perspective, you would have given me a D". While that little pedagogical conversation was going on, Grandma entered the room with a few other students, sat down in an armchair just opposite the large canvas, and told us a story that went with the picture.

The students grouped around her. They sat on the floor and the chairs and the bench listening carefully to what Grandma had to tell. At that moment I presented her with a bouquet of roses which still were in a box, since we had bought it in a little town on our way to Hoosick Valley. Grandma tried to undo the knot of the string, but that did not work so well, and I reached into my pocket for my big painting knife in order to cut the stubborn string. "Oh never". Grandma shouted, "you must never cut string. That one must never do". And her tiny fingers wrestled bravely with the string until she actually had it undone.

The roses created great joy, and without thinking about it, Grandma suddenly started singing "The Last Rose of Summer". It happened so suddenly and so naturally that I am sure that nothing else would have suited the whole situation better than her soft singing of that old tune.

While still finishing the last stanza, Grandma suddenly beamed, and we could tell that she had something else to tell. "Do you know', she asked me, "do you know, when I got roses the last time?—Four years ago I got my last roses." We knew that that was not all she wanted to tell, and patiently we waited for more to come, and with a meaningful smile she added, "Yes, four years ago I got my last roses, and from a Dutchman too!" Grandma clearly had recognized by my way of speaking whence I came, and with that little story she wanted to let me know quite humorously what she knew.

Grandma soon added another story which had some connection to roses. "Oh, I once had wonderful rose beds," she said. "Yes, very wonderful rose beds, there were no better ones in our valley. But then my son came back from the war, and he wanted to make something out of our farm, and I bought him a bulldozer. You know what that boy did! The first day he had the bulldozer he destroyed all my beautiful flower beds!'

Gradually the hour of farewell came, and Grandma asked me not to say good-by—we should just leave and act as though we would return very soon, otherwise it would all be too sad. "But before you leave," she said, "I want to tell all of you something you should accept from an old lady, and that is the advice to be much more thrifty. Don't waste so much of your paints when you work in oils or water colors, and don't always buy that expensive canvas. Take hard card board or masonite. Look at my pictures—they are all painted on masonite, and they will stay unchanged eight hundred years, even if they are harmed by
(Please turn to page 34)

(Continued from page 32)

weather and water."

The life of Grandma Moses always has been a life of thrift and careful planning. She comes from a family of ten children in the state of New York. When twelve years old, she had to start working as a hired girl with a rich family in her home town. She drove "Old Black Joe" to church for the family on Sunday mornings, she placed bouquets on the pulpit in the church, and she took care of the mistress of the house, who was an invalid. Grandma had not had much schooling—three months in summer and three months in winter, but she did not always go to school in the winter: "Little girls did not go to school much in winter, owing to the cold, and not warm enough clothing,"[2] therefore the noticeable absence of school life and school-scenes in her work. In 1887, when she was 27, she married farmer Thomas Moses. They wanted to take a honeymoon-trip down to North Carolina, but in Staunton, Virginia they were talked into staying there: "We got as far as Staunton, Virginia, where we planned to stay over the week-end, and there we were kidnapped, or should I say persuaded, to go no farther and to settle in the middle of the Shenandoah Valley. So we hired a farm near Staunton, Virginia, for a year to see if we would like the south."[3] The young couple soon became very busy; many items were still scarce and difficult to obtain in the generation following the Civil War. The husband farmed, and the young wife made marmalades, and potato chips, which she sold. And she gave birth to ten children. In 1905 the Moses family moved back to the North, to New York State. But down in the Shenandoah Valley they had left five little graves. For twenty-two years Mr. and Mrs. Moses lived and worked in New York. Then, in 1927, Thomas Moses died. Mrs. Moses went on with her own way of earning money. She continued to make marmalades and potato chips, "which was a novelty in those days."[4] And now, as a hobby, she took up needle work. She did pictures in needle work, her "yarn pictures" as she calls them. When her eyes became rather weak, her sister suggested that Anna should try oils instead of fine needle work scenes. And Anna was always ready to try something new. They found a piece of old canvas from the cover of a threshing machine and some old house paint, and Grandma started doing oils and neglected more and more the yarn work which had become so hard on her eyes. The pictures became better and better, and Dorothy, the daughter-in-law, suggested one day that Grandma should exhibit them in the village drug store.

She did so. Next to her marmalades (of which she is the proudest!), and

(Please turn to page 36)

[2]Grandma Moses, American Primitive. See footnote 1.

[3]Grandma Moses, American Primitive. See footnote 1.

[4]Grandma Moses, American Primitive. See footnote 1.

(Continued from page 34)

her potato chips, she showed her oils, which were put into the window. "This is where the ball started rolling,"[5] says daughter-in-law Dorothy, because (and this all seems like a movie) into the drug store came a stranger from the big city. He had been passing through the village and was attracted by those canvases. Their freshness, their bright colors, their decorative force, their childlike way of telling old and heart-felt stories, their well-balanced composition charmed his art-loving heart. He asked for the artist's address, and heard to his surprise that it was a lady of almost eighty years. The stranger's name was Louis Caldor, and Grandma mentions it with very great delight. She still recalls his coming to her home and buying four pictures. That was quite an event in her life; she often had given paintings away when good marmalade customers made a large purchase, or she had painted them "on order" for a little fee, which aways depended on the picture's size.

Yes, that stranger became the hero of this wonderful story. Mr. Caldor returned to New York, grew more and more enthusiastic about his purchase and was finally able to arrange an exhibition of Grandma's pictures in New York. That was in 1940, nine years ago. Grandma was eighty years at that time and had just begun painting. The first exhibit at the Gallery Saint Etienne was so successful that Gimbel's Department Store soon asked permission to put on another at the exhibit hall of the store, and also asked Grandma to attend the opening of that show. Grandma accepted the invitation and travelled to the big city, which she had not seen for thirty years. Oh, how New York had changed! And she could not quite figure out why she should play such a big role in that change. She saw her name in the New York papers, she saw her pictures in them and those sensational head lines, "Farmer's Woman Turning To Fame," or "Grandma Moses, The Typical American Woman," or "Grandma Moses Or: Career Starts at Eighty."

Hundreds of people had been invited to the opening. Many more had come. Loud-speakers announced her arrival, and press photographers took her picture, scaring her when they flashed their glary bulbs. There was so much commotion, pushing, and cursing, and in the midst of all this she was suddenly asked to speak into the microphone. Grandma, who tries everything, tried the microphone too. She was told to say something about her way of painting and about her canvases, but when she saw so many ladies among the listeners, she felt that painting would be too impractical a subject, and she started talking about her marmalade, how she prepares them, how she sugars them, how she cans them, and how much of this and how much of that should be added. While she was still at her preferred subject, making marmalades, she suddenly stunned the somewhat puzzled audience by reaching into her little travelling bag and producing as though by magic a few small jars of her own marmalade products, so that those ladies could see that she did not know her recipes only by theory.

Painting has always been a secondary matter in the life of Mrs. Moses. Why then should she tell about a secondary matter at such a special moment in her life? The simple duties of a farmer's wife seemed to her more important and more interesting. And I believe it is just in this very fact—that Grandma never pretended to be anything else than what she is, a hardworking lady who is also successful in art—that she speaks so closely to our hearts. She became 88 years old a few months ago, but she goes on working as usual. She paints every day and lives her customary life. In her paintings she reports everything she can think of, anything she can recall. She reports it all in a childlike fashion, since it is mostly childhood that she depicts, the "good olden days," when she was singing, "Over the river and through the wood Oh, how the wind does blow, It stings the toes, and bites the nose, As over the ground we go."

Painters who depict scenes in a childlike fashion are called "primitives". I know that Grandma does not quite like that label, and she mentioned that to me. She does not quite realize that primitive painting can have the same results as painting by highly-trained people. We admire many primitives of past centuries and

(Please turn to page 38)

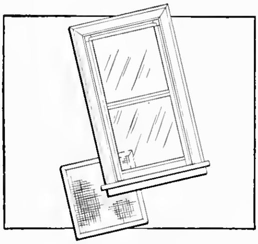
[5]*Grandma Moses, American Primitive.* See footnote 1.

BUSINESS IN MOTION

To our Colleagues in American Business . . .

A rather recent development in the housing field is the combination screen and storm window. This is installed permanently, and greatly eases the otherwise difficult job of changing from screens to storm windows and vice versa. An exceedingly interesting new window of this general type has just been shown to Revere because it is made of a Revere brass.

The new window is entirely brass-framed, and fits flush into the house window, making it wind-and-weather tight. It has two brass-bound glass panes sliding in brass channels and held firmly in place by a simple brass slide. These panes, either or both, can be removed by hand in a few seconds from inside the house, and a screen panel substituted. At the bottom of the window is a narrow brass insert which can be removed if only a small amount of ventilation is desired. An additional feature is the provision of a slip joint with 5/8 inch play to take up expansion and contraction such as sometimes occurs, particularly in new houses, and to permit adjustment to older houses whose windows may not be quite true or uniform in dimensions.



Brass is a generic term, because copper and zinc can be successfully alloyed in various proportions. Thus there are many brasses. In addition, each is available in different tempers, gauges, and the like. The manufacturer of this window said that he had always regarded brass as a quality material, and never thought of using anything else. Since the method of fabrication requires severe forming, including some 180-degree bends, he came to Revere for assistance in selecting the right alloy, temper and annealing technique. The result is a window that is good looking, with a golden red color. Under difficult weather conditions, as at the seashore, it stands up and should outlast the house. Naturally, it cannot rust, rot, or warp.

Revere's collaboration with the window manufacturer is typical. When requested, we are delighted to tell all we know about our many metals, not only the brasses, but also bronzes, coppers, and aluminum alloys. These are made in various forms, including sheet and strip, bar, rod and wire, forgings, and extruded shapes. The latter, incidentally, in brass, copper and aluminum, have many architectural uses, including windows, thresholds, hand rails and the like.

We regard every material as having its own advantages, many of which are not shared with other products. That is why there are so many different Revere metals and alloys, offering a wide choice. This diversity of products, and complete knowledge about them, is customary in American industry. No matter what any supplier makes, he is well informed about it, and is only too glad to share his knowledge. After all, his customers make it possible for him to increase his business and his knowledge. In other words, you pay for both experience and materials. Are you using both?

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

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(Continued from page 36)
far-away countries. We admire moderns who became forcefully primitives because they felt to continue painting in a conservative, academic fashion was a dead end artistically. Grandma never had lessons on perspective, color combination, composition. She uses her own color combination, her own perspective, and her method of composition. There is nothing thought-out about it, nothing tricky, and nothing stunning. She just talks in paints, and if there is a white spot left on her canvas, high up on a mountain top, and she feels that spot should be filled, then she will fill it. She may paint a little barking dog into that spot, and that barking dog may be just as big as the dog in front of the house in the foreground of the picture. We know that cannot be, but when we see the canvas, we are touched by it. That little dog up there barking all by itself is perhaps lost or afraid of a fox or hungry. And when Grandma paints snow scenes, she just can't stop telling you how wonderful the Hoosick Valley is; she puts Christmas tinsels on the wet oil, and when someone tells her that "should not be done" because it is "unacademic", that it "is not done", then she will simply answer you that she sees it that way, and that is that.

Painting out of her heart, which is a heart of love for her home and her people and all the people she knows, telling stories of things and experiences that touched her, or meant something to her, or frightened her, and continuing to do just that—this makes Grandma Moses a great woman.

The world, grateful as it can be at times, has recognized that greatness of Grandma Moses. Just while writing this essay, I received an Albany paper with the head-line, "Grandma Moses will be Televised With Paintings", and then, in smaller print, it reads, "Eagle Bridge Artist, 88, also will be in Movies Saturday Night and Will See Whole Show from Own Home." The striking thing in this love between Grandma Moses and the public is the extraordinary use of the latest modern devices of technology to carry her art to the people. Never before has a painter been honored and publicized in so generous a fashion after such a comparably short career. We only hope (and when I say "we", I mean "we artists", because I regard myself as one), that with these latest events in the life of Mrs. Moses, modern science and technology have shown an ability and a desire to help fill that realm of human activity which the modern age so easily neglects.

Technology's aid in putting Art before a large public—to help it gain a place in the sun again, in the sun of our artless life—is gratefully received by all artists. And the fact that the *Illinois Tech Engineer*, the periodical of one of the most progressive scientific institutions of higher learning, asked me to write on Grandma Moses shows clearly that, within the realm of Science and Technology, there is a great longing to put Art back where it belongs—into its place as a rightful companion of all the other fields of human knowledge.


Served in the
BEVERLY HILLS HOME OF
Mr. and Mrs.
Edward G. Robinson

Engineers and Unions

(Continued from page 9)

tions. These distinctions, taken by themselves, are frequently trivial — like punching a time clock—but they cut much deeper than that; for instance, there are those who believe that the standards by which their work performance is evaluated are not adequate. Some also feel that too many engineers are unnecessarily laid off in a retrenchment of the working force; they claim that there are long range research projects to which engineers could be assigned during slack seasons.

It is interesting to note that most of the grievances felt by these engineers are not primarily concerned with money. To be sure, a demand for higher compensation is usually present, but most of the arguments center about elevating the professional standards of engineering careers. Organizational literature shows a preoccupation first with attempts to improve the standards of the entire engineering profession and second with drives for higher pay.

There are indications that a sizeable group of the engineers intent on organizing are still management oriented in their loyalties. Frequently you will hear statements to the effect that "top management and its policies are not at all bad, but the way those policies are carried out by the lower levels of supervision is what really rubs us the wrong way." This sort of distinction, implying a kind of acceptance of top management while at the same time rejecting lower echelon supervisors, is not at all uncommon from shop employees either. But it hardly need be pointed out that far more skillful supervisors are required to direct the work of highly-educated engineers than are ordinarily needed for a shop.

While the stated policies of top management are frequently rated and publicized by the engineers' organization as excellent, the endorsements are followed by bitter criticism of immediate supervisors. Vague supervisory explanations why an individual was passed up at "raise time," supervisory failure to notify the engineers in advance when they must work overtime, or supervisory failure to notify them in advance when overtime work is no longer necessary—these are all common examples of this kind of dissatisfaction. Each may not appear to be very important taken by itself, but when you place them all in a larger context they take on more meaning. This larger context we have in mind is the shrinking area for mobility, for advancing upward in the structure of the company.

Many large corporations show signs of approaching hardening-of-the-arteries in an organizational sense. Supervisory, semi-executive, and executive positions are always limited in number. Competition for these jobs is characteristically keen. It is the American tradition that only the best men can hope to occupy these positions. But it is also the American tradition that the most effective escalator for personal mobility is through our educational system. Almost all engineers go through rigorous training in engineering institutions. They expect that training to pay off for them. After they graduate and get jobs they look around to see what opportunities lie ahead of them. When they learn, as so many of them do (particularly in the larger corporations), that they cannot hope to compete for the superior jobs until they have put in 15 to 20 years service—or even more—they become increasingly critical of their treatment.

We believe this restricting area of mobility to be one of the major problems of American industry today. The desire to climb the ladder to the stars has been one of the mainsprings of human motivation that accounts for a great deal of the spectacular achievements of our industrial civilization. When that goal appears to become limited, a distinct pattern of human readjustment takes place. Because competition for the superior jobs in the big corporations is so intense and because

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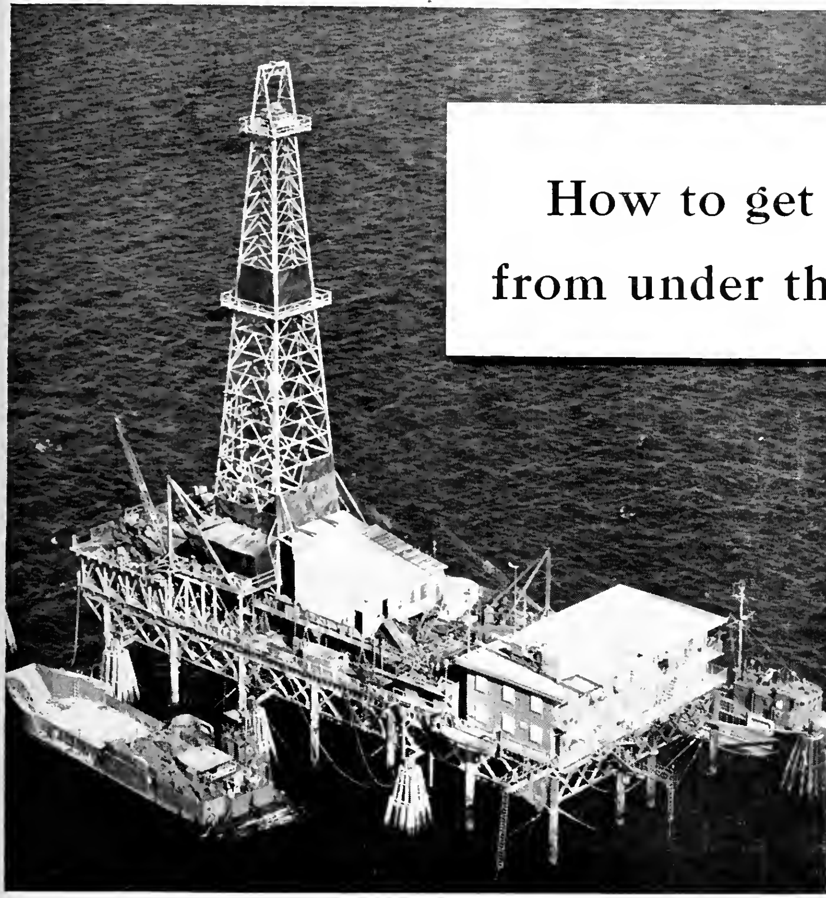


How to get oil from under the sea

OUT of sight of land, miles offshore in the Gulf of Mexico, oil is now being brought from under the bottom of the sea.

Through its subsidiary, the Stanolind Oil and Gas Company, Standard Oil undertook to develop this new source of oil to help fill the growing need of Americans for petroleum products of all kinds. Offshore drilling presented our technical men with brand-new problems. These were solved so successfully that oil hitherto unavailable is beginning to flow to refineries, and products made from that oil are helping meet the public's huge demand.

This is important news to an oil-hungry nation, now and for the future. It is also a tribute to the ingenuity and skill of the Stanolind Oil and Gas Company men who engineered the project. There are places in Standard Oil for other men who, in the research and operating departments, can help find new ways to provide more and better petroleum products.

Standard Oil Company

(INDIANA)

STANDARD

STANDARD SERVICE

(Continued from page 40)

the large companies require a longer "seasoning time" for promotion, professional groups like engineers become hypercritical of their own rate of advancement. They become dissatisfied with any inadequacies of their own supervisors. They turn to professional organizations like engineering unions, for a larger voice in the whole enterprise and for a redress of their grievances. The union is under pressure by its longer service members to protect their years of experience in the company. The formula for advancement becomes more heavily weighted with seniority. And the cycle becomes complete.

This is the whole point: here is an entire profession in which many of its members do not feel that they are being treated as professional people; and they intend to do something about it.

How can management deal with this problem? It is certain that nobody has the definite answer. It does not look as though the tactics successful with shop employees will apply to engineers. New attitudes and new tactics must be learned.

While we do not pretend to have the answers, we can make a few observations that might be pertinent in a general sense.

1. This problem will not disappear if management sticks its head in the sand and denies the existence of the problem. The movement has acquired too much strength, the trend is too distinct to be banished by wishful thinking. A real forward step would be merely to recognize that a problem exists.

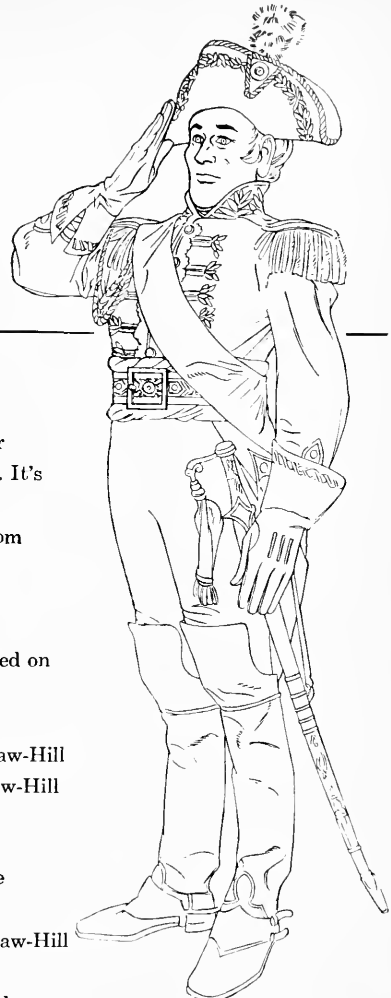
2. If management is willing *to call* its engineers and technicians "professional people" and "staff employees," is it also ready *to treat* them in a professional manner? Is it, for instance, necessary that these "professional people" punch a time clock? Is management willing to hear any suggestions its engineers might have toward improving the standards of evaluation for their work performance? Is management ready to listen to any proposals from its engineers on stabilizing employment so they are not the first to "hit the street" during a cutback? These are honest questions; they require some intelligent thinking and some honest answers.

3. Management can look this problem of restricting mobility squarely in the eye. How many companies have made a genuine inventory of their executives? How long were these executives with the company before they were promoted? What were their educational backgrounds? From what kind of communities did they come? And more important, what are the real opportunities for advancement that lie ahead for promising young engineers? A lot could be accomplished by management if it simply said: "Let's dig into this problem. Let's talk about it and see what the situation really is."

4. An important field frequently neglected is the training of the engineer's supervisors. Do they receive adequate training in leadership or are they indoctrinated with the glib cliches that characterize so many supervisory training problems? It is important to remember that the caliber of supervisory skill demanded of these men should be much higher than that usually required of other supervisors.

These suggestions are intended to stimulate management to an examination of structure of the situation in which engineers find themselves today. Problems such as these can be understood better when viewed in terms of the human organization. Engineers are flesh and blood men with ambitions, hopes, and fears that extend beyond the confines of the organization in which they work, and the degree to which they serve their company enthusiastically and spontaneously depends, in large part, on the degree to which their needs are satisfied.

While the unionization of engineers might appear as a heresy to management, it cannot be dealt with effectively on an ethical basis. We believe that it calls for intelligent and constructive re-examination of many of management's own policies and practices. If this is done, the heresy might never result in an actual cleavage between management and its engineers.



Current & Future Research . . .

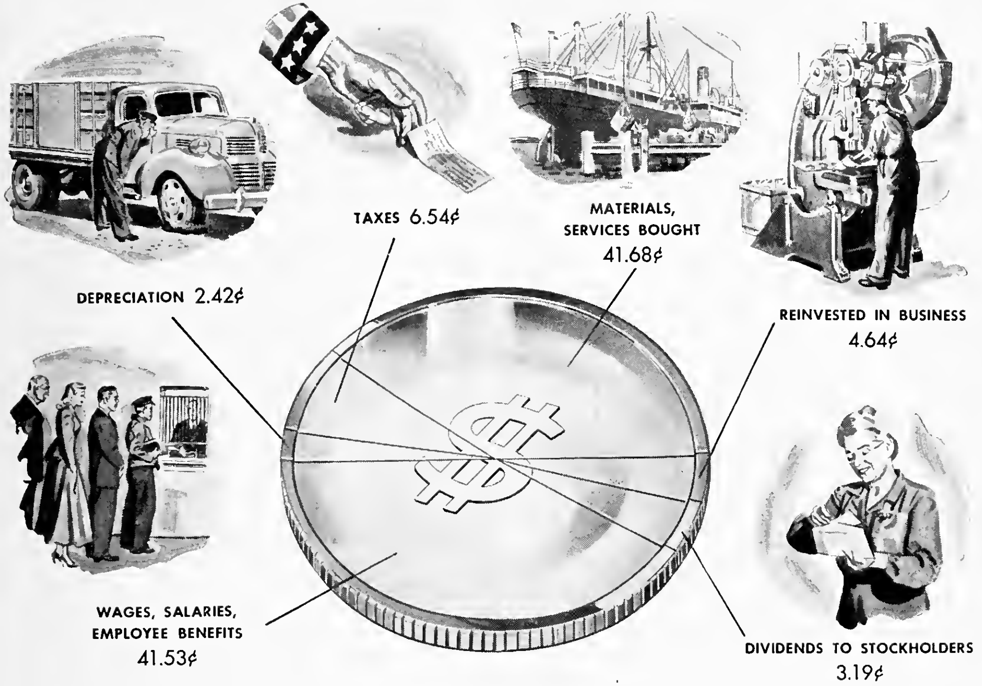
(Continued from page 12)
of fuel gasified per unit of time and of the gas compositions. These data are being used to compute the process equilibria rates of gas making and to establish the reaction kinetics. In some tests carbon dioxide has been substituted for oxygen to obtain more uniform bed temperatures and to study the mechanism of the gas-making reaction. The temperature range from 1700 to 2000°F has been rather completely explored, and further tests are contemplated at temperature levels up to 2300°F.

A second reactor was built to study materials of construction as well as gas-making reactions. This unit was designed to operate at atmospheric pressure, but with both ceramic tubes and metal tubes, to determine, if possible, the influence of the reactor-wall material upon the gas-making reactions.

The effect of pressure as a variable is being studied in a third reactor designed to operate at pressures up to 600 psi. This reactor has some unusual design features; the reaction tube is independently supported within the shell and the pressure differential between the inside of the tube and the interior of the reactor shell is balanced to within one-quarter of a pound regardless of the pressure level. The reaction tube is externally heated with a preheating section and three reaction sections to insure control of temperature distribution throughout the tube length. A temperature-balancing coil is placed intermediately in the insulation to maintain the reaction system within the tube under adiabatic conditions. Initial tests have been made at two and five atmospheres pressure and the unit has been tested at 30 and 40 atmospheres pressure. The pressure range of two to three atmospheres at the same temperature levels employed in the atmospheric pressure reactions will be explored to establish the increase in gas-making capacities which can be obtained through moderate increases in operating pressures. The pressure level of two to three atmospheres is well within the potential pressure limits for modification of existing water gas equipment. These tests may demonstrate the possible increases in capacity which could be obtained if existing water gas sets were converted to moderately higher operating pressures.

Enriching Value of Oils for Carburetion

The study of the enriching value of oils for carburetion at the Institute was preceded by a survey of laboratory testing methods used within the gas industry. The results of this study were used in designing a laboratory cracking furnace and in designating the auxiliary equipment for the oil testing laboratory. The gas production research committee made the sum of *(Please turn to page 46)*



HOW TO DIVIDE UP A DOLLAR

. . . the American Way

It may interest you to know the mistaken notions most folks have about the profits of American companies.

They tell interviewers that they *think* such companies are entitled to make 12 to 15 cents on every dollar of income. as a fair return. Yet, they add, it's their guess that manufacturers *actually do* make about 25 cents!

The facts are that in normal years American companies average about *nine cents* profit per income dollar.

Take Aluminum Company of America in 1947, for example. Out of each dollar received last year by Alcoa and its subsidiaries, the net profit amounted to *less than eight cents*. We show above where the rest of that dollar went. Nearly half of it in wages, salaries, and employee benefits, to Alcoans. Almost another half for materials and services we bought. Over six and a half cents for taxes.

The dollars-and-cents story of Aluminum Company of America represents the kind of facts you'll get from any typical American enterprise. Facts that show a fair return for a good product.

By dividing up a dollar, the American way, Alcoa has provided secure employment for 46.000 aluminum workers and has helped America to gain world leadership in aluminum production and research.

ALCOA
ALUMINUM ®

Aluminum Company of America

(Continued from page 44)
$10,000 available to the Institute for the purchase, or construction, and installation of the necessary equipment, enabling the Institute to obtain an excellent research facility for oil evaluation.

A review of oil testing methods was first prepared and reported to the committee. The initial study of the optimum approach for determining the enriching value of oils was then begun. In this study, enriching values obtained in the Institute's laboratory cracking furnace were correlated against the physical properties of the oils, employing the method proposed by earlier investigators and using the UOP "K" factors, aniline points, various distillation ranges, and finally, carbon-hydrogen ratio. The carbon-hydrogen ratio appeared to give the best correlation and had the added advantage that it could be determined with greater facility than the data required for any of the other correlations developed by previous investigators. However, the procedures require equipment which might not be available in every gas plant laboratory, so three methods were developed for estimating the carbon-hydrogen ratio from relatively simple tests. The estimated carbon-hydrogen ratios were then compared with the carbon-hydrogen ratios obtained by analysis for some 15 oils covering the entire range of enriching materials from light, straight-run gas oil to catalytically cracked residues containing 13 percent Conradson carbon. The estimated and determined carbon-hydrogen ratios were in such close agreement that these estimated values may be used for differentiating between various types of oils which are or can be made available for carburetting purposes.

The above method — first estimating the carbon-hydrogen ratio and then, from this estimated value, determining the probable enriching value of the oil—should provide a useful tool for the gas industry in the purchase and utilization of oils in both carburetted water gas and high-Btu oil gas production. The gas production research committee has authorized the preparation of a manual outlining these tentative "methods for estimating the enriching values of oils in gas plants" which will include the nomographic charts used in obtaining the estimated carbon-hydrogen ratios, a chart containing a correlation of carbon-hydrogen ratios with laboratory cracking test enriching values, outlines of the modified test procedures which were employed in obtaining the data for estimating carbon-hydrogen ratios and the equations for computing oil gas volumes and tar yields. This manual will be distributed to selected operating companies with requests that they test these methods by comparing estimated enriching values with operating results. These data are to be forwarded to the Institute for further study and correlation in order to establish the value of this procedure. Samples of oils which apparently do not correlate with the laboratory test data will be sent to the Institute for analyses and laboratory cracking tests to determine why the plant carburetting values devi-
(Please turn to page 48)

“—*The resources of civilization are not yet exhausted*”—WM. E. GLADSTONE

Why greater strength weighs less and less

CAN YOU MAKE three pounds of steel do the work of four . . . and stay on the job longer? The answer is YES, with *alloy steels*—steels that are combined with small amounts of other metals, such as chromium, vanadium, and zirconium, to develop or increase desired qualities. For example, it's the element, *chromium*, that gives the stainless nature to steel.

So great is the improvement in steel, when alloy agents are used, that a freight car of alloy steel can weigh 25% less, haul heavier loads, yet stay in service much longer than similar cars of ordinary steel. Alloy agents not only increase the strength of steel, they also extend its life through reduction of destructive factors such as rust, corrosion, and wear.

The use of better materials to make steel go farther and serve longer is especially vital to all of us . . . with steel mills unable to catch up, and ore supplies dwindling.

Industrial gases have a big role in steel's better performance, too. Compressed oxygen aids in cleansing the molten steel . . . the oxy-acetylene torch cuts steel sections to size—and welds them together if desired. Finished steel articles are given a harder, longer-wearing surface through "flame-hardening." And carbon, in the form of electrodes, makes modern electric furnaces possible . . . with their output of high quality steels.

The people of Union Carbide produce these and related materials for improving steel. They produce hundreds of other materials for the use of science and industry—to the benefit of mankind.

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ACHESON Electrodes • NATIONAL Carbons • PRESTONE and TREK Anti-Freezes • EVEREADY Flashlights and Batteries

(Continued from page 46)

ate from estimated values. When this approach has been definitely established, the test procedures will be widely disseminated as the method for selecting oils for carburetion.

At present the study of enriching values of oils is being extended to include crude oils and this will be followed by tests at higher pressures to determine the effect of pressure upon enriching value and by tests to determine the value of preheating oils prior to cracking. Preheating to 600 to 900°F under pressure will provide for sensible-heat storage in the oil. The oil will immediately vaporize on admission into the carburetor insuring a longer period of relatively higher temperatures in the vaporizing section, which permits the entire set to operate at higher capacity. The more uniform temperatures in the carburetor should improve efficiency by insuring cracking in the vapor phase rather than the distillation of liquid from the checkerbrick surfaces. This approach should be particularly advantageous in high-Btu oil gas production where the heat requirements in the vaporizing section determine the amounts of oil which may be used per run. An increase in efficiency will lower material costs, and an increase in capacity will lower both investment and labor charges per unit of gas produced.

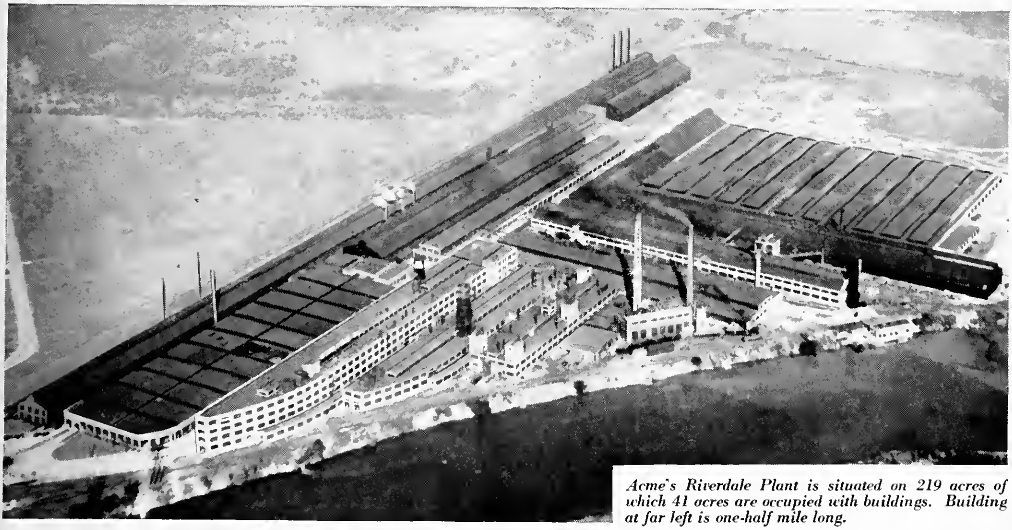
Organic Sulfur Research

The organic sulfur research program, since its inception and until last year, has been directed toward the determination of individual organic sulfur constituents in fuel gases. A tentative procedure has been reported to the gas industry and is now being employed in certain plants where organic sulfur is a particular problem. During the past year, the removal of carbon oxysulfide and carbon disulfide with amine-carrying solutions and the study of reagents for thiophene sulfur removal have been carried forward. Columns with heights of 30 and 60 inches and diameters of one and two inches have been set up in the laboratory. These columns, packed with glass beads, steel helices and more recently ceramic beryl saddles, and using varying rates of flow of both gas and scrubbing solutions and varying concentrations of sulfur and of amines, have been employed to study the effect of these variables upon sulfur removal. Initial sulfur contents of 15 to 20 grains have been reduced to one-half to one grain. At present, the influence of moisture and carbon dioxide upon the efficiencies of scrubbing a gas containing 20 grains of either COS or CS_2 to a maximum of one-half grain in the scrubbed gas is being determined. From these data, scrubbing units will be designed to remove the undesirable components.

Forced Combustion in Domestic Cooking

The Institute is carrying forward a study of forced combustion for domestic cooking for the technical advisory group for burners, controls and accessories research of the committee on domestic gas research. The niceties of control which are obtained through

(Please turn to page 50)



Acme's Riverdale Plant is situated on 219 acres of which 41 acres are occupied with buildings. Building at far left is one-half mile long.

ENGINEERING OPPORTUNITIES TODAY AT ACME STEEL COMPANY

Because of unusual emphasis on engineering talent Acme Steel Company has been able to introduce and to profitably manufacture many special steel products for industry. Items manufactured range from steel slat stock for venetian blinds to machines that take the place of rivets and welding by stitching through metal without prepunching; from ceiling louvers to steelstrapping for package reinforcement; from stitching wire to car bracing bands, and a host of related items for the packaging and shipping trade, plus the machines and tools with which to use the products.

Imaginative engineering and aggressive management have made Acme Steel Company outstanding in the fields where it competes. The advancements in Acme Steel have included more than fine technical advances in production and manufacturing. They have also included the development of progressive and sound personnel policies. Acme Steel Company provides group life, hospital, surgical, and sickness and health insurance. A retirement plan is also available to eligible employes.

If you are interested in being associated with a company such as Acme Steel Company, write for details to C. M. MacChesney, Ex. V. P., Acme Steel Company. 2840 Archer Avenue, Chicago 8, today.

ACME STEEL COMPANY

2840 Archer Avenue   Chicago 8, Illinois

FACTS YOU SHOULD KNOW ABOUT ACME

SALES — $60,000,000 annually   GENERAL OFFICES — Chicago

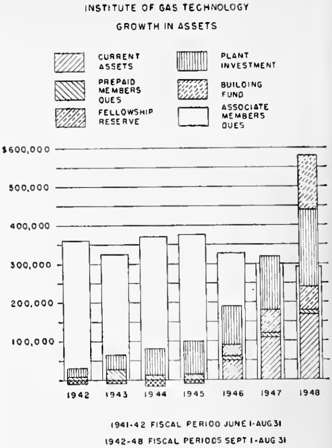
PLANTS — 3 — All in Chicago Area   EMPLOYEES — 4000

PRODUCTS — Steelstrapping, Corrugated Fasteners, Strapping Tools, Hot & Cold Rolled Strip Steel, All types of Hoops, Bag Ties, Louvers, Venetian Blind Slat Stock, Stitching Wire, Stitching Machines.

(Continued from page 48)
mechanical aeration as practiced in industrial utilization appear to offer substantial advantages in domestic cooking. This study will develop these advantages and point out the difficulties of accomplishing mechanical mixing in multiple burner, multiple appliance installations.

Natural Gas Research and Technical Advisory Committee

During the past four years the Institute has been able to extend its research facilities for manufactured gas problems with the advice and counsel of the gas production research, technical advisory, and project supervising committees. A natural gas research and technical advisory committee, composed of outstanding research and operating personnel within the natural gas industry, was formed to outline the types of research and to designate specific projects with which the Institute should be concerned. This committee, divided into three sections, the Appalachian, Gulf Coast and California areas, and chairmaned by Dr. R. W. Miller, has held three meetings. As a result, a comprehensive outline for research has been prepared for the Institute. Of these problems, the Institute has been able to undertake research to date on phase equilibria in the nitrogen-methane system, and the solubility of propane-butane in air with the determination of dew points for propane-butane air mixtures, and has equipment on order to undertake a comparison of the apparati used for determining the deviation of natural gas from the ideal gas laws. The first of these studies will be of assistance in developing equipment for the separation of nitrogen from natural gas. The second will facilitate the use of isobutane and butane with propane-air mixtures as substitutes for natural gas. The third will be of real value in determining the density of natural gas in metering at pressures up to 4,000 pounds. Paralleling these studies, masters' theses are directed toward determining the heat transfer coefficients for methane and nitrogen at liquefaction temperatures and toward the formation of propane-butane hydrates in natural gas.



Coal Carbonization Research

The Institute is in the process of reactivating its coal research laboratory and has recently obtained a Gieseler plastometer, a new ball mill, a Roller particle-size consist analyzer and a B-E-T vacuum surface measurement unit. It has under construction apparatus for the simultaneous measurement of temperature rise, gas evolution and expansion pressure in the carbonization of coal, and has recently employed two full-time staff members to study the independent and dependent variables in coal carbonization. A master's thesis is also being carried forward in this field to study the effect of bulk density upon the three dependent variables mentioned above.

Growth of Institute's Facilities

The growth of the Institute in the last seven years is indicated in the accompanying chart which shows the increase in total assets. On September 30, 1948, the total assets including subscriptions to the Building Fund and associate members' dues which are payable under the terms of the agreements of membership, plant and current assets exceeded one million dollars. When the Institute's new building, now under construction, is completed and the expanded facilities are fully available for the more vigorous
(Please turn to page 52)

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prosecution of research, the anticipated contribution of the Institute to the gas industry will more nearly approach realization.

Accompanying this growth in research facilities has been an improvement in the preparation and presentation of "gas abstracts" and the formal presentation of the Institute's research in a Research Bulletin series. The first three numbers describe, "The Storage of Natural Gas as Hydrate", "Equilibrium Compositions and Enthalpy Changes for the Reactions of Carbon, Oxygen and Steam" and "Supplying Household Heating Services by High Temperature Circulating Liquids and Vapors." The reference library has been enlarged and a full-time head employed for the information service. A News Letter outlining the Institute's current activities has been initiated and several numbers have been issued.

The educational program has been re-established through substantial contributions to a fellowship fund by leading utility companies and three non-utility companies. Since re-establishment, one doctor of philosophy and six masters of gas technology have been graduated, and all but one have been employed in the gas industry or by an associate member company. This employment marks the final phase in the Institute's plan of service through education and research. These graduates will make a continuing contribution to the gas industry during the entire period of their employment.

The educational program is potentially the main channel through which the Institute may serve. The gas industry must obtain its fair share of outstanding young men to provide reinforcements for senior personnel. Young men with a complete understanding of the underlying principles of the gas industry gained through training and research will provide the best replacements for the industry's present personnel who now direct its operations with wisdom gained through long years of experience. These replacements must be continually inducted into the gas industry, to first assist and then succeed those who are now in positions of responsibility.

The Institute of Gas Technology was founded by members of the gas industry to provide both research facilities and trained personnel. In its first seven years it has made considerable progress through the enthusiastic support, both technical and financial, of its associate members. These members have increased, the facilities have been expanded, the personnel of the Institute has become more seasoned, the numbers of men in training have increased, the quality of its research has improved, and the quantity of its research has expanded. The hopes and ideals of the founders are more nearly achieved now than during any other period in the Institute's short life. The future is approached with the conviction that, as the results of the Institute's research are employed and as the Institute's graduates are given greater responsibilities, the gas industry will continue to provide more and better service to more and better communities at lower comparative costs.

Biology in Action

(Continued from page 14)

molds destroyed or inhibited the growth of desired bacteria, none of them until Fleming had performed experiments upon the quantitative aspects of this inhibitory activity. Even though the results of this work were published (1929) in a British journal, nothing came of them for 10 years. Florey, another Englishman, revived interest in the problem by duplicating and expanding the work of Fleming. Both found that the *Penicillium* mold produced a substance that was inhibitory to *staphylococcus aureus*, several other Gram positive bacteria and a few Gram negative forms. Furthermore, the inhibitory fluid when sufficiently purified was relatively non-toxic for man and other animals. This finding is very important, for many good inhibitory agents against bacteria are likewise toxic to higher animals. Such compounds may only be used for skin applications, providing they do not cause undesirable reactions. Soon after Florey's experiments in 1939 and 1940, British and American scientists cooperated in the further work of production and purification of penicillin. During the war, a variety of scientists in large numbers were, by concentrated activity, able to obtain a highly purified product in considerable volume. In this instance as with the atomic bomb, the fundamental discoveries had been made in Europe and with the aid of unlimited funds for production development, success was achieved.

The original mold used by Fleming and Florey was identified *penicillium notatum*. This mold at the beginning of the war only formed two Oxford units of penicillin per ml. of liquor under the conditions employed at that time. The early penicillin, even upon a production basis here in the United States, was produced by growing the mold upon a nutrient solution in small flasks. Sometime later, techniques were developed whereby the mold could be grown in submerged culture in large tanks with oxygen supplied by many small bubbles of sterile air. Many strains of penicillia were tested for their ability to produce the antibiotic; one of the most effective isolates was taken from a spoiled cantaloupe in Peoria. Other groups of scientists, by the use of ultra violet light and x-rays, were able to produce mutant strains which would provide much more penicillin. Students interested in the nutrition of the mold determined that lactose and corn steep liquor, in addition to the other required nutrient salts, enhanced penicillin production many fold. By the combined efforts of these different scientific groups, a mold strain was obtained, which when grown under optimum conditions could yield several thousand Oxford units per ml. of

(Please turn to page 56)

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liquor, in contrast to the two units per ml. obtained several years ago.

Although penicillin is active against some streptocci, micrococci, gonorrhea and syphillis organisms, not all bacteria are inhibited by penicillin. In fact some bacteria form an enzyme *penicillinase* which digests or neutralizes the antibiotic. This enzyme is useful in testing the drug penicillin for freedom of contaminating infectious bacteria. Recent work has indicated that some bacteria grow more rapidly in the presence of a particular antibiotic than in its absence. This could be very serious; the disease might then become worse upon the administration of additional antibiotic. Many other antibiotics have been produced in the laboratory and a few are being produced on a large volume basis. All of these substances are more or less excretion products of bacteria, actinomycetes or molds. *Streptomycin*, originating from the actinomycete *streptomyces griseus* is active against certain types of tuberculosis, meningitis, pneumonia, and tularemia organisms. Other antibiotics of promise are *chloromycetin*, inhibitory to typhoid, typhus, Rocky Mountain spotted fever organisms, and *aureomycin*, counteracting the disease caused by certain viruses and undulant fever and osteomyelitis germs.

The microbiologist, in conjunction with the chemical or fermentation engineer, has been able to produce these products in ever increasing amounts with corresponding decreases in cost. During the first 10 months of 1948, some 76.6 trillion Oxford units of penicillin were produced, compared with 30.6 trillion units for the complete year of 1947. The hospital price for 100,000 units in Jan. 1, 1945, was \$2.50; in 1946 it was 55 to 95 cents; in 1947 it was 38 cents and in 1948 just 10 cents. In 1947, about 9,000,000 grams of streptomycin were produced, compared with 27,000,000 grams for the first 10 months of 1948. The current streptomycin cost to hospitals is \$1.60 per gram. Chloromycetin and aureomycin are entering production stages at the present time.

Physiology and biochemistry. The

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experimental method in biology was firmly established by William Harvey about 1650 when he determined the path of blood circulation in the human body. For two centuries thereafter progress in the experimental sciences was slow; however, within the past 100 years tremendous advancements have been made. Furthermore, until a few decades ago, physiology was nearly always associated with man and other mammals and biochemistry was limited largely to human physiological chemistry. The modern physiologist or biochemist is often times more interested in the function and metabolism of cells in organisms other than man and other mammals. Hormones (such as adrenalin and insulin) and vitamins are required in the metabolism of a wide variety of animals. All of our knowledge concerning these substances has been formulated within the past 50 years.

Large numbers of biologists are studying the physiology and biochemistry of plants. Although this subject developed later than did animal physiology, recent surges have yielded much new information. For instance, it is now known that plants produce auxins (helpers) or "hormones" which may be elaborated in the roots and cause activity in the leaves or stem, or the process may be reversed. The familiar growth or bending of a plant stem toward the light is due to the liberation of auxins on the shaded side of the stem; these in turn stimulate the adjacent cells to increase in size and thus the localized enlargement causes the stem to "bend" toward the light. Instances of practical uses of auxins include: stimulation of young fruit to mature without fertilization or seed development; spraying of young fruit on the tree to prevent premature dropping; treatment of potatoes in storage so they will not sprout; death of unwanted broad-leaved plants, or weeds. Another active aspect of plant biochemistry is the analysis of photosynthesis. This process, whereby the green chlorophyll in the presence of light is able to catalyze the union of carbon dioxide and water to eventually form glucose and other products, is a reaction of utmost importance, for it supplies all our food and fuel.

From the discussion in the preceding paragraphs it must be obvious that many geneticists must be biochemists and microbiologists. Accordingly, an increasing number of biochemists are becoming interested in genetics and microbiology. The reason for this convergence is the realization that many of the fundamental activities for all living cells are the same. Therefore, all biologists are interested in the ultimate fate or activity of enzymes, vitamins, nucleic acids, and food nutrients as fats, proteins and carbohydrates. Many of the vitamins become integral parts of enzymes, and the genes, with high percentages of nucleic acids, in turn control enzyme formation and perhaps activity. Recent aids for the understanding of these interactions are the isotopes, non-radioactive and radioactive. These isotopes are likewise valuable in experiments upon photosynthesis and atmospheric nitrogen fixation. By using isotopic materials, the biochemist is able to synthesize compounds containing radicles with "tagged" atoms. In fact, plants are employed for the synthesis of some of the more complex chemical compounds for use in similar experiments. These chemicals with the "tagged" atoms are then subjected to the metabolic experiment in question. By the use of the mass spectrometer or Geiger or other radiation counter, the experimenter may determine whether the isotopic atom or radicle entered into some new chemical combination or remained attached to its original molecule.

The instances just cited above are examples of the rapidly growing importance of physics and especially instrumentation to the experimental biologist. For most effective experimentation, the individual should not only be a good biologist, but should also be familiar with the theoretical aspects of the instruments. This important and rapidly developing area of science is called *physical biology* or *biophysics.* Other techniques which are becoming of increasing importance in the study of biological problems are: electron and ultra violet light microscopy, x-ray and other types of radiation, electrophoretic studies, ultra centrifuges, infra red and Raman spectroscopy, ultra violet and visible light absorption spectrophotometry, x-ray diffraction studies, supersonics, and ultra violet and visible light spectroscopy.

Biology, it can be seen, is not a subject that deals only with the classification of insects and flowers or the dissection of animals. Rather, it is a field that is dynamic and challenging and urgent, for it is the science of life and of all things that live.

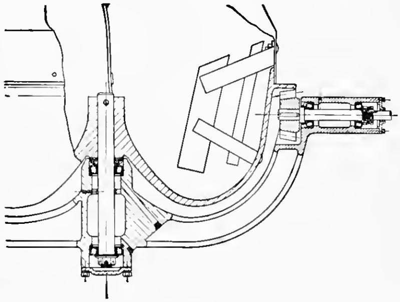
Another page for **YOUR BEARING NOTEBOOK**

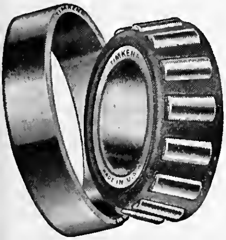
How TIMKEN® bearings pave the way for long life in a concrete mixer

Keeping concrete mixers from growing old too soon is the aim of construction equipment builders. That's why they use Timken® tapered roller bearings on drum shafts, driving pinions, and in the road wheels. Because Timken bearings practically eliminate friction and keep parts in rigid alignment, wear is reduced to a minimum.

TIMKEN® bearings keep gears meshing smoothly

This drawing illustrates how Timken bearings are used to insure smooth operation in a concrete mixer. Because of the tapered design, Timken bearings take thrust as well as radial loads. End-movement of shafts is eliminated and parts are held in rigid alignment. Timken bearings carry the heaviest loads with minimum shaft deflection. Gears wear longer—work better.





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Some of the important engineering problems you'll face after graduation will involve bearing applications. If you'd like to learn more about this phase of engineering, we'd be glad to help. For additional information about Timken bearings and how engineers use them, write today to The Timken Roller Bearing Company, Canton 6, Ohio. And don't forget to clip this page for future reference.

NOT JUST A BALL ○ NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

Develop Microwave Measurement Standards

As part of the broad program for the establishment of national standards and calibration services for all electrical quantities at radio frequencies, microwave measurement standards are being intensively developed at the National Bureau of Standards in the range from 300 to 100,000 megacycles and above. This work, under the direction of Dr. Harold Lyons, has resulted not only in extremely precise and accurate standards of frequency, power, attenuation, and other quantities, but has also made possible precision measurements in a whole new field of microwave spectroscopy formerly inaccessible to investigation because of the limitations of infrared and optical equipment. Of basic importance in the microwave program has been the development and continued improvement of a primary standard of frequency accurate to one part in 100 million. This standard, based on a quartz-crystal clock and a frequency multiplying system governed by the time observations of the U. S. Naval Observatory, is now being used by the Bureau to provide a regular service to Government and industry consisting of frequency measurements and calibrations of frequency meters and voltage sources.

As a result of research carried on under the pressure of World War II, a vast new spectrum of radio frequencies above 300 megacycles is now available for application to radar, navigation systems, storm and weather reporting, relays for FM and television broadcasting, blind bombing, guided missiles, and many other uses, both peacetime and military. The fundamental requirement for opening up and fully exploiting this new microwave region, however, is the development of national standards and measurement methods for frequencies up to 100,000 megacycles or more. Such standards are necessary tools for the design, development, and production engineering of practical electronic equipment, as well as for basic research as in nuclear physics. Many of the new techniques in atomic energy work, in particular some of the recent billion-volt nuclear particle accelerators, depend upon accurate microwave measurement methods and equipment. Microwave standards are also important in the development and proper use of a number of industrial and medical applications of radio and electronics, such as dielectric heating for case-hardening metals, rubber curing, plastic molding, food processing, textile fabrication, and radio therapy.

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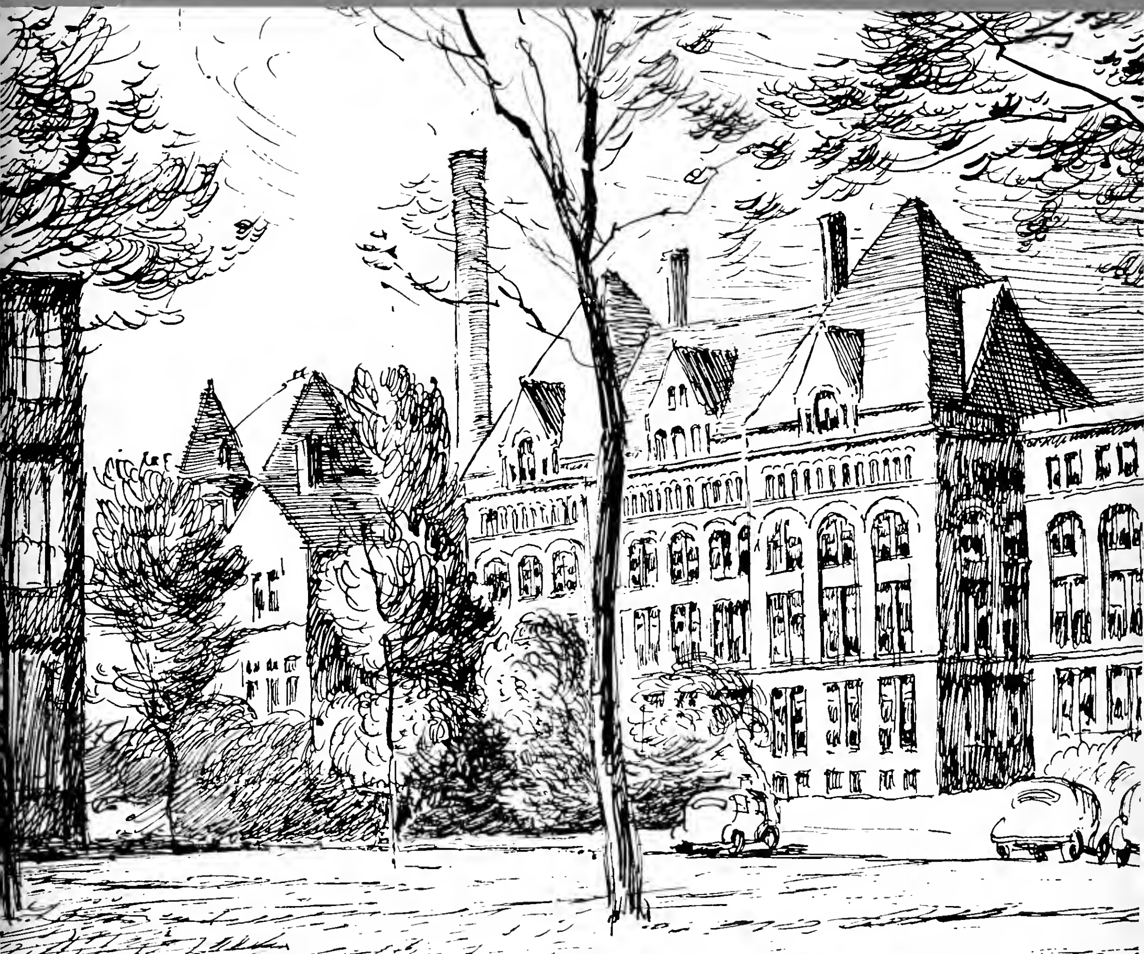
BAILEY, N.C.
(FROM A SERIES OF STATEMENTS BY PROMINENT TOBACCO FARMERS)
MAKE YOURS THE MILDER CIGARETTE

ILLINOIS TECH

Engineer



MAY, 1949

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Johnny Vander Meer

After many seasons with the Cincinnati Reds, he has more strikeouts to his record than any pitcher on the Club. Vander Meer is the only big leaguer to pitch two "no-hit" games in a row.

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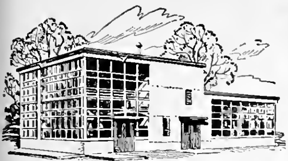
Yes, smoke Camels and test them in your "T-Zone" (T for taste, T for throat). Let your own taste tell you about the rich, full flavor of Camel's choice tobaccos. Let your own throat report on Camel's cool, cool mildness.

Money-Back Guarantee!

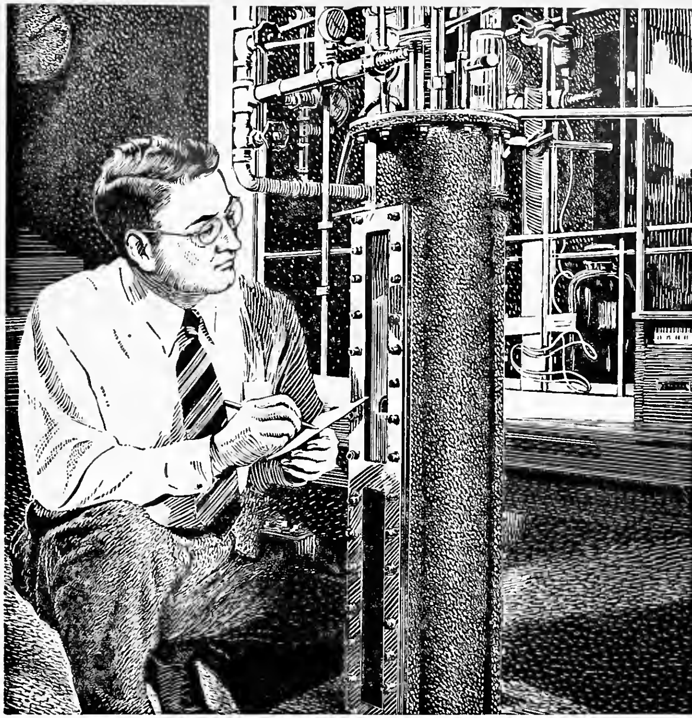
Try Camels and test them as you smoke them. If, at any time, you are not convinced that Camels are the mildest cigarette you ever smoked, return the package with the unused Camels and we will refund its full purchase price, plus postage. *(Signed)* R. J. Reynolds Tobacco Company, Winston-Salem, North Carolina.



NEW LABORATORY UNIT, *part of G-E Research Laboratory, is the center of General Electric research into such low-temperature phenomena as...*

SUPER-FLUIDITY *of helium—meaning that at near-absolute zero it loses its viscosity, can spin forever ...and*

SUPER-CONDUCTIVITY—*the loss of all electrical resistance by some materials below about 15° absolute.*



Near absolute zero, matter does strange things...

At 455 degrees below zero Fahrenheit, liquid helium becomes a "superfluid." That is, it loses its viscosity; if it were to be set in motion like stirred coffee spinning in a cup, part of it would theoretically continue to spin forever.

It also becomes a "super-wetting" agent, meaning that it will creep up the sides of a container and flow over the edge.

Other types of matter develop the property of "super-conductivity." Columbium-nitride, for example, loses all electrical resistance below 15 degrees absolute. If an electric current were set in motion in a closed loop of this substance, it would in theory flow indefinitely.

These are some of the facts of cryogenics—the study of low-temperature phenomena—into which a group of young General Electric scientists are directing their investigations.

So far their studies are in only the earliest stages. But already the facts of this nether world of temperature have aroused enough interest that with the building of a new Research Laboratory near Schenectady, a $250,000 laboratory unit has been especially constructed to aid and amplify their work.

Through its emphasis on research and creative thinking, through encouraging fertile minds to follow their own imaginative bent and by implementing their work with the best available facilities, General Electric remains "a place where interesting things are happening," and stays in the forefront of scientific and engineering development.

You can put your confidence in—

GENERAL ELECTRIC

Contributors . . .

Jack S. Castiglia is a junior in the fire protection and safety engineering curriculum at Illinois Tech. He was graduated at Lane Technical high school, Chicago, in 1938. During World War II, Mr. Castiglia served for three years and 10 months in the United States Signal Corps. For more than half of that time he was stationed in China. He entered Illinois Tech in March, 1946, under the G.I. Bill of Rights.

Royden Dangerfield is professor of political science at the University of Wisconsin. A graduate of Brigham Young university and the University of Chicago, he also studied at the Geneva School of International Studies and the London School of Economics. In 1942, while on leave after 20 years as professor at the University of Oklahoma, he served as chief of the blockade division of the Foreign Economic Administration. Dr. Dangerfield was appointed chief international law officer in the Navy department in 1944 and in 1945 became assistant chief in charge of research in the Department of State. He was named consultant to the Bureau of Budget for the Commerce and State departments in 1948. Dr. Dangerfield is author of *In Defense of the Senate*, co-author with Cortex A. Ewing of *Documentary Source Book on American Government and Politics*, and co-editor with David L. Gordon of *The Hidden Weapon: The Story of Economic Warfare*.

Otto Eisenschiml has won recognition as a chemist, lecturer, author, book reviewer, and authority on Lincoln. Born in Vienna, he was graduated at the Polytechnical School of Vienna in 1901 and in the same year sailed for America where he became a chemist for the Carnegie Steel company, Pittsburgh. He was chief chem-
(Please turn to page 4)

Cover Picture: This sketch of the Illinois Tech campus by Vernon Howe Bailey is reprinted from the New York Central Railroad menu honoring the Institute. As one of a series of tributes to colleges and universities in towns served by the system, the menu is now appearing in New York Central dining cars.

VOLUME 14 NUMBER 4 MAY, 1949

ILLINOIS TECH Engineer

IN THIS ISSUE

Published October, December, March and May
Subscription rates, $1.50 per year.
Editorial and Business Office, Illinois Institute of Technology, 3300 Federal St., Chicago 16, Illinois.

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ist for the American Linseed Company from 1904 to 1907 and from 1907 to 1912 was manager of that firm's South Chicago plant. Since 1912 he has been owner and president of the Scientific Oil Compounding Company, Inc. In 1914 he founded the *Chicago Chemical Bulletin* and was editor of the *Bulletin* from 1914 to 1917. In 1914 he was also chairman of the Chicago Section of the American Chemical Society. Dr. Eisenschiml has always taken a deep interest in the problems of the working chemist. His writings include *Why Was Lincoln Murdered?*, *Reviewers Reviewed*, *In the Shadow of Lincoln's Death*, *Without Fame*, *Chicago Murders* (co-author), and a number of scientific treatises.

Earl C. Kubicek, executive secretary of the Illinois Tech Alumni Association since 1946 and director of alumni relations since 1947, has done considerable study on Abraham Lincoln, Mark Twain, and Sir Arthur Conan Doyle's Sherlock Holmes. His collection on Lincoln, the most extensive of the three, contains more than 500 volumes including some rare and valuable pieces. A graduate of Armour Tech in 1933, Mr. Kubicek holds membership in the State Historical society, the Abraham Lincoln association, and the Lincoln

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• *TO OUR READERS*

With this issue, the publication of the *Illinois Tech Engineer* is discontinued.

The *Technometer*, monthly alumni publication, will continue to bring you news of the Institute's campus and alumni activities. If you are not receiving the *Technometer* at present and would like to be placed on its mailing list, you may do so by writing to the Director of Alumni Relations, Illinois Institute of Technology, Technology Center, Chicago 16.

The editors of the *Engineer* wish to send their thanks to the advertisers, to those persons who have contributed articles or who have helped in some other way during the past 14 years to make the magazine a respected and welcome periodical and to all of those who have read and enjoyed it.

The Editors

IN the period from 1941 to 1945, fires in residential properties caused an average loss of $103,620,000 a year. Over the same period the loss in manufacturing plants was $79,160,-000 and the loss in mercantile establishments was $82,250,000 a year. The last two figures are mentioned because they are connected with large businesses, where it is the rule to take great precaution against fires.[1]

These statistics are in themselves enough to make one stop and think, but they become insignificant when one considers another cost of fires—the loss of life. Those who have been through the experience of a serious fire do not need to be told what it means. For the rest of us, it can only be said that a fire can happen in anybody's home.

1. N.F.P.A. Handbook (Fiske and Crosby Forster), p. 13

The question is: what can we do about it? Large businesses generally try to do everything they can. Factories, stores, and warehouses are protected by automatic fire-fighting systems and alarms. Many have their own fire departments. The private homes, where the losses run much higher, have been left without any special protection. We rely on ourselves or on the neighbors to notice the fire and call the fire department in time. But all too often the fire occurs at night, or for some other reason it is not noticed until too late. The protections available to large businesses have been beyond the reach of the individual.

It is still true, perhaps, that we must rely mainly on the municipal fire department to put out the fire. The private individual may do what he can, before the fire engines arrive, check the flames and reduce property loss, but at present the main responsibility for the job lies with the established system of fire departments. However, there is one thing the private individual can do that may reduce his property damage and, more important still, help to save the lives of his family. A well-planned alarm system can warn the occupants of the house that a fire has started, usually in time for an escape to safety. An early warning will also make it easier for the firemen to do their job. Many people may think that such a system is too expensive even to consider. However, this is not the case. Almost any home can be protected by a simple, effective alarm system which is so inexpensive that practically everyone can afford it.

One of the fraternities on the campus of Illinois Institute of Technology

*Junior in the fire protection and safety engineering curriculum at Illinois Tech.

ne fires from burning...

by JACK S. CASTIGLIA*

has installed such a system, and it is proof of the feasibility of this kind of protection in private homes. Almost any one can plan the installation, buy the equipment, and put it in for himself for about $25. If he needs help to do the job, it may cost a little more. In any case, the added feeling of security should be more than worth the small cost.

A simple alarm of the type referred to is electrically operated from the lighting system. Wires are strung from room to room in a manner to be explained later in this article. These wires make up a circuit to a warning bell. As long as the circuit is complete, the bell does not ring, but if any of the wires is broken apart anywhere in the house, the warning is sounded. The system depends on heat from the fire to open the circuit. This is accomplished by inserting links made of soft metal at various points in the electrical circuit. The links are located at the danger spots all over the house. If a fire occurs near one of the links, it melts and falls apart. This breaks the circuit, and at once the bell rings. The planning and installing of such a system will be described in detail.

The fusible link is the heart of the system. Each link is made of two short strips of brass, about one and one half inches long, one-half of an inch wide, and one-eighth of an inch thick. A special alloy with a melting point of about 160°F. is used to sweat the two pieces of brass together. The strips are attached to each other overlapping as shown in the illustration. Holes drilled in the exposed ends are used to make connections to the wires with bolts. By putting a stable at this point, one end of the strip is held fast to the ceiling or wall. The other half of the link is fastened to a spring, placing one end of the spring between the head of the bolt and the link. The spring is stretched and hooked onto a screw a short distance away. The link is thus kept under slight tension, so that when heat softens the alloy, the link will be pulled apart with positive action.

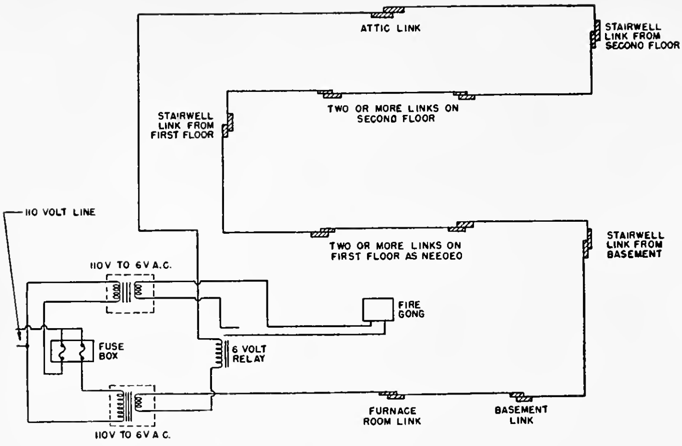
It will be best to make about 10 ounces of the alloy. This is much more than one is likely to need, but it is difficult to weigh smaller quantities. The components are as follows, quantities determined by weight.[2]

Bismuth	*5 ounces*
Lead	*2 2/3 ounces*
Tin	*13 1/3 ounces*
Cadmium	*1 ounce*

The metals can be obtained, preferably in powdered form, from a chemical supply house. The Central Scientific Company, for instance, can supply them. If the different metals cannot be obtained in those exact quantities, they can be weighed on a

2. American Society of Metals Handbook, 1948, p. 744

At left is the ordinary fire alarm bell used in the home alarm system described. At the right is the fusible link, "the heart of the system". A link of this type should be placed in the circuit at danger spots throughout the home.



SCHEMATIC DIAGRAM

good postal scale. The measurements must be precise; unless one is careful to weigh the metals accurately, the alloy will not have the right melting point.

It would be best to use a small ceramic crucible for making the alloy. The bismuth is melted first. Its melting point is 520°F., and it can easily be melted on a gas range. The lead is then added to the fused bismuth. As the lead dissolves, the heat may be reduced, for as each component is added, the melting point of the mixture is lowered. The tin is melted in, and then the surface of the melt is covered with powdered charcoal. This prevents the cadmium from oxidizing. The cadmium is now added and the mixture is stirred for a few seconds. By this time the flame should be very low, for the melting point of the entire mixture is well below the boiling point of water. If the alloy is overheated, its melting point will be too high. The mixture is allowed to cool and can then be used like solder to sweat the brass strips together.

The operation of the system is shown in the circuit diagram. The 110-volt side of an ordinary bell transformer is connected directly to the load side of the main switch. A special fuse is provided for the alarm system, so that it will not have to depend on the fuses for one of the lighting circuits. The secondary supplies only six volts to the wires connecting the fusible links. This voltage is low enough that ordinary bell wire can be used for the circuit, and exposed parts of the circuit could not possibly cause a personal hazard. With the primary of the transformer connected directly to the entrance switch and the secondary circuit closed, current is flowing at all times through the links and the relay coil. This current is very small; the amount added to the electricity bill would be negligible.

The current through the relay coil holds the relay operated, and under these conditions the circuit to the alarm bell is open. If a break occurs anywhere in the secondary circuit, the relay will cease to receive current and will restore. This closes the fire gong circuit and rings the gong. The gong is shown powered by a 28-volt transformer. If a smaller bell is used, it could be powered by another 6-volt transformer, but it is important to make sure that the sound of the bell is loud enough to arouse the household and that it cannot be mistaken for the doorbell. The relay must be of the A-C type; that is, it is constructed so that it will not vibrate on 60 cycles. It must have a "normally closed" set of contacts; in other words, the contacts must be closed when there is no current through the coil.

The line to the fire gong transformer has its own fuse. Both of the fuses (with about a 3-ampere rating) are located in wires going to the "hot" side of the entrance switch. The location of the fuses in the circuit is very important. It will be noticed that the fire gong line is not connected between the bell transformer and its fuse but between the toggle switch and the bell transformer fuse. If for any reason the fuse to the bell transformer should blow, the line to the gong transformer will not be opened. Instead, as soon as the 6-volt transformer line opens, the relay will restore, and the gong will ring. This is a warning that the system is temporarily out of commission and is incapable of serving as a fire alarm. So if the alarm sounds, and there are no signs of fire in the house, one knows that some damage, either an open or a short, has occurred to the system, and he can look for the trouble and correct it.

In installing the system, it would be well to locate the transformers, the fuses, and the toggle switch near the main electric switch. All connections on the primary side of either transformer are 110-volt wiring and must satisfy electrical code requirements. The toggle switch should be in a switch box, and all connections to fuses and transformer primaries must be adequately insulated. It may be necessary to use armored cable for the primary wiring. This is one reason for grouping the transformers close to the main switch; then only a few feet of cable will be needed. In most houses this equipment can be fastened to the basement ceiling. Since none of the circuits carries much current, No. 18 conductors would be more than adequate. The secondary circuits use ordinary bell wire. If the relay is mounted close to the transformers, the wires to the relay contacts can be made very short. The alarm bell should be centrally located, so that it may be heard equally well in all parts of the house. It should be as much in the open as possible, so that the sound of it will not be muffled by walls or closed doors.

The success of the system depends upon using care in locating the fusible links. One should make a careful survey of the house, determining in each room where a fire would most likely start or where it would most likely be felt first. In the basement the furnace

(Please turn to page 20)

Mr. Sherlock Holmes:
SCHOLAR *AND* SCIENTIST

by Ear icek.

WEBSTER says that a scholar is "a learned person of thorough literary or scientific attainments." and that a scientist is "one learned in science."

Who, having followed the course of Sherlock Holmes' many brilliant case deductions made public through the medium of the writings of the versatile Dr. Watson, can say he was not a scholar and scientist in every sense of the words? Holmes displayed a rare discernment by applying his vast knowledge in the fields of the arts and sciences to the successful prosecution of his many cases.

When the time came for Holmes to retire from active practice, a quiet little "farm upon the downs five miles from Eastbourne" beckoned. Here Sherlock Holmes could carry on his researches and experiments in philosophy and agriculture. We know of the exact location of this retreat through the writings of Holmes' Boswellian friend, Dr. John H. Watson who, as colleague and collaborator, shared Holmes' many adventures in the bizarre.

Holmes' establishment is a small one, including the master, his old housekeeper and his bees. This little estate, exclusive in its solitude, is a far cry from the Baker Street house—a combination bachelor apartment and laboratory—occupied jointly by Holmes and Dr. Watson. Number 221B Baker Street was the mecca for many anxious persons seeking a solution to their problems, problems too complex to be entrusted to the regular authorities. Only the brain of the famous Mr.

William Gillette, American playright and actor who became, through the medium of the stage and his singular likeness to Sir Arthur Conan Doyle's conception of the character, the one person most people thought of as the living Sherlock Holmes. (Drawn from life by Frederic Dorr Steele, reproduced through the courtesy of Denis P. S. Conan Doyle for the Conan Doyle estate.

Sherlock Holmes could be relied upon to solve these difficulties.

Dr. Watson, in making public the adventures of Mr. Holmes, opens many of the stories in similar fashion. Having a fine sense of the dramatic, he sets the scene by painting word pictures of the weather—the beating of rain upon the window pane, the howling of November winds in the chimney—that seems peculiar to London. To all followers of the adventures of Holmes and Watson these introductions are warmly familiar. and the mere mention of them induces a peculiar nostalgia.

The sound of hurried footsteps on the stairs of 221B Baker Street. the impatient jingle of the doorbell, a hurried whispered consultation with the faithful Mrs. Hudson, and finally the pleading anxiety of the client for the help of the master as the case is discussed—this is a scene dear to the heart of the true follower of Holmes.

It was no mere happenstance that Mr. Holmes was much sought after in the many intricate problems that plagued his clients. He was a scientist firstly; his methods and his application to the problems at hand were scientific.

Our first introduction to Holmes underscores his passionate interest in scientific research. After Watson and "Young Stamford" had met in the Criterion Bar and discussed the years that had intervened since their last meeting, Watson expressed an interest in Stamford's friend as a possible roommate. The pair went to a hospital laboratory to meet Sherlock.

Notwithstanding Stamford's rather perfunctory description of Holmes' ability as a chemist, his studies in anatomy and his wide acquaintance in many other fields of science, Watson was intrigued. The description of such a personality may have aroused some doubts in his practical mind of the advisability of teaming up with such an exotic figure.

The scene in the hospital laboratory awakened memories in Watson's mind of his own student days. It would be in such a place that we would expect to find Holmes, in spite of the fact that it was a holiday. He was holding forth in his experiments alone. Watson was fortunate to be present at the moment when Holmes had just brought to a successful conclusion an experi-

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***Executive secretary of the Illinois Tech Alumni Association and director of alumni relations.**

by EARL C. KUBICEK*

Occupational Aptitude Testing

by PHIL S. SHURRAGER*

THE aim of all those concerned with hiring, placing, training, transferring and promoting employees is, first, to hire only those who are likely to make good employees, and second, to place each individual where he will be most useful and contented. Objective tests are the modern tools which, properly used, make the achievement possible. They are more reliable bases for evaluating employees than the subjective estimates of even experienced and successful personnel officers. No reputable industrial or clinical psychologist would consider evaluating anyone's abilities without test results as a basis.

Objective tests are fair at all levels of employment. They are advantageous to the employee and to the employer. They place the former in a job which he can handle adequately and protect him from the partiality or animosity of his supervisors. They are a check upon the fairness and accuracy of supervisory ratings.

Objective tests are not, however, fool-proof tools. They must be chosen, administered, and interpreted by trained personnel; they must be accurate measuring devices; they must measure qualities which the job in question requires; and it must be possible to recognize the implications of the scores obtained. Only when all these requirements are met should the use of tests for selection become a routine employment procedure.

Companies which hire large numbers of people are well advised to use tests developed exclusively for them. There are several advantages to such a course. The tests themselves can be designed to measure those qualities

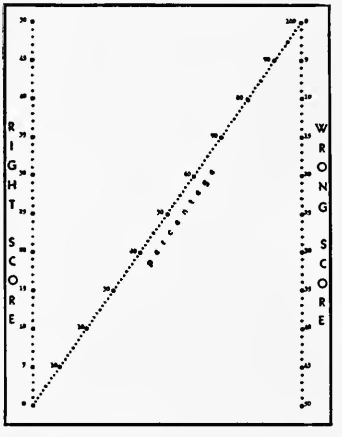

Fig. 1

which are most valuable to the company. The inclusion of items which do not measure abilities requisite to job success has the effect of lowering the correlation between test scores and job performance. For this reason, tests which measure special abilities are more useful than so-called "general ability" tests. The test which is constructed specifically to measure qualities essential to job success is the best selective tool.

The vocabulary of the company-owned test and its actual problems can be based upon the tools and processes used by the company. The relationship between test and job will thus appear more plausible to the employee and his attitude toward the program will consequently be improved. Finally, tests whose use is restricted to a single company are less likely to fall into the wrong hands. Standard tests, available to all qualified purchasers, are apt to be circulated; they thus lose some of their value.

It should be emphasized that test results are not infallible. Whenever possible they should be supplemented by an interview and by the history of the individual. However, there is no question that test results provide a reliable basis for final evaluation and that they are very valuable when screening out applicants worthy of interview.

When test scores are appraised by employers who have intimate association with current employees, the results sometimes seem fallacious. They appear so in some instances because the employer requires certain qualities which the test was not designed to disclose.

Consider the relationship of executive and secretary; it is personal to a degree seldom found in the factory or shop. Technical inefficiency in some aspects may be condoned because of other qualities which appeal to the executive. Aptitude tests will not therefore tell how satisfactory A's secretarial work will be in B's eyes. They can only provide an impersonal rating of how A will output competitively with others in the aspects of secretarial work which have been selected for test appraisal.

Job Aptitude

Job aptitude is the sum of all traits, native and acquired, of intellect and personality, which predispose for success on the job. If an individual possesses aptitude for a particular kind of work or specific job, it does not necessarily mean that he has acquired skill in the performance of that work. He may, in fact, be totally unfamiliar with the job in question. However, he does possess a pattern of abilities, or interests, or knowledge, or a combination of these, which will enable him to acquire skill readily in the performance

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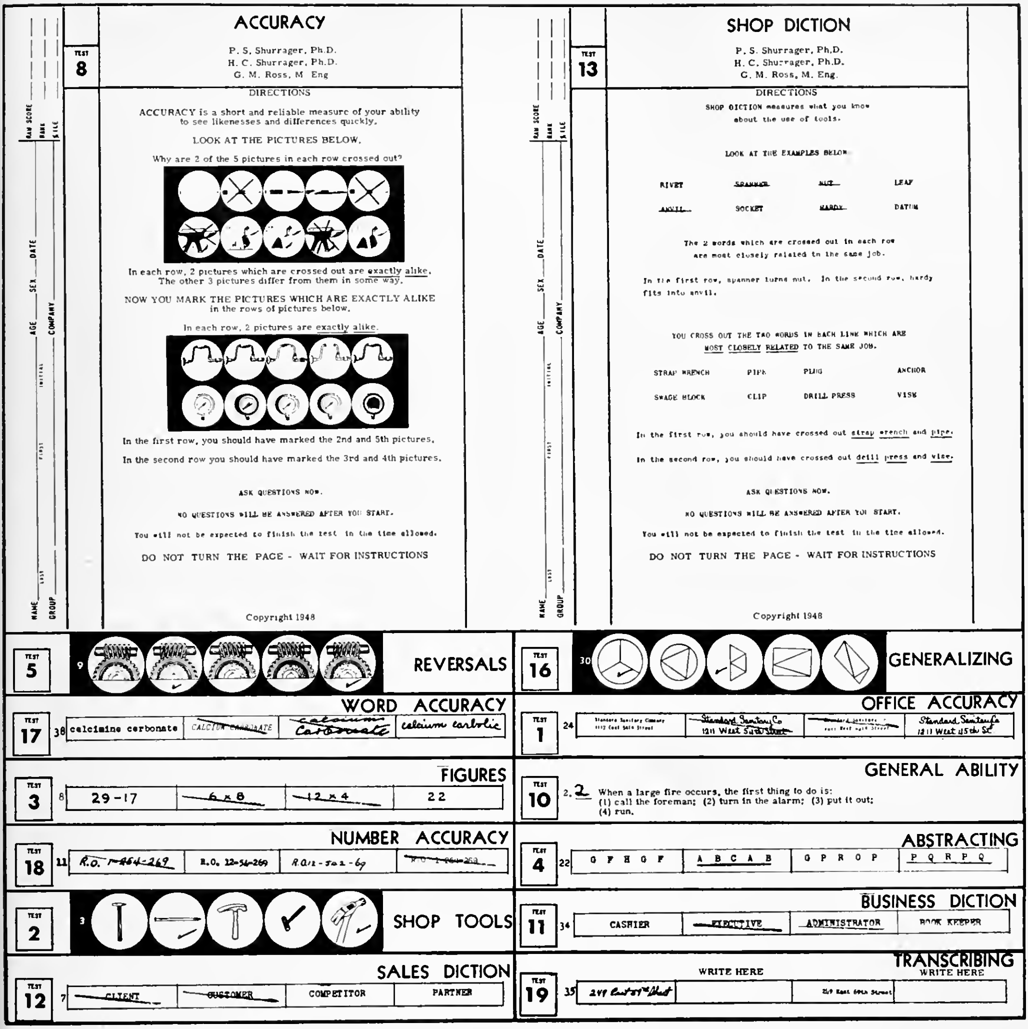

Fig. 2

of such work and to perform well and consistently after he has learned.

There are broad aptitudes which suit an individual for work in certain fields. One who is required to work with tools in any trade should possess mechanical aptitude. A basic pattern of abilities and interests is common to those who will be successful in office work. A different and quite stable pattern of aptitude characterizes people who will succeed in a variety of selling jobs. To these broad aptitudes are added special aptitudes for special jobs within the job field.

Those who are required to supervise and direct others should possess aptitude for this kind of work, preferably in combination with good aptitude for work in the field in which they supervise. Aptitude for supervision includes such qualities as a relatively high level of general intelligence, ability to reason, foresee, and plan, plus responsibility and dependability and such other qualities and knowledge that the particular job may require, all in proportion to the complexity of the job.

The Aptitude Test

An aptitude test is one which measures an individual's interest in, knowledge of, or innate ability for, information or performances which are known to be related to success on the job. For practical reasons, a battery of short specific tests is often used instead of a single composite test.

Many abilities contribute to success-

Table I

COLLEGE STUDENTS

%	ROUGH RANK	TESTS 1	2	3	4	5	6	7	8	10	11	12	13	15	16	17	18	19	%
100	(9) Exceptional	43	36	50	48	42	46	17	42	26	45	46	46	15	15	33	40	29	100
99		41	30	47	43	42	42	13	41	25	42	46	43	14	13	31	40	27	99
96		37	26	44	40	42	37	12	39	23	39	44	39	12	11	27	38	26	96
95	(8) Very Superior	36	25	43	39	41	36	11	38	22	38	43	38	11	10	26	37	25	95
91		35	22	41	36	41	33	10	37	22	37	42	36	11	10	25	37	24	91
90	(7) Superior	34	21	40	35	40	32	9	36	21	36	41	35	10	9	24	36	23	90
81		33	18	39	31	40	30	8	36	21	34	39	31	10	8	23	35	22	81
80	(6) High Average	32	17	38	30	39	29	7	35	20	33	38	30	9	7	22	34	21	80
71		31	17	37	28	39	28	7	34	20	32	37	28	9	7	21	34	21	71
61		30	15	35	25	38	26	7	33	19	30	36	26	8	6	20	33	20	61
60	(5) Average	29	14	34	24	37	25	6	32	18	29	35	25	7	5	19	32	19	60
51		28	13	34	24	37	22	5	31	18	29	34	25	7	5	19	32	19	51
41		26	12	32	23	35	19	5	30	18	27	33	23	6	5	18	31	18	41
40	(4) Low Average	25	11	31	22	34	18	4	29	17	26	32	22	5	4	17	30	17	40
31		24	10	31	22	34	15	4	28	17	26	31	21	5	4	16	29	17	31
21		23	9	30	20	32	11	3	27	16	24	29	19	4	4	15	28	16	21
20	(3) Below Average	22	8	29	19	31	10	2	26	15	23	28	18	3	3	14	27	15	20
11		20	5	26	19	29	7	2	24	15	22	27	16	3	3	13	25	15	11
10	(2) Low	19	4	25	18	28	6	1	23	14	21	26	15	2	2	12	24	14	10
6		19	4	25	17	25	6	1	21	13	20	25	13	2	2	11	24	13	6
5	(1) Very Low	18	3	24	16	24	5	0	20	12	19	24	12	1	1	10	23	12	5
2		13	2	23	15	14	4	0	19	9	17	21	6	1	1	10	20	10	2
1		11	0	22	12	1	2	0	16	5	14	14	3	0	0	8	19	9	1

Row scores representing the limits of each Rough Rank are determined by interpolation, so that the Rough Rank interpretation of raw scores can be made by any clerk in the personnel department.

ful job performance and different combinations of abilities form patterns which fit various jobs. Quite different jobs may require the same ability, but in different combinations and perhaps varying degree. To construct a single composite test to measure aptitude for each of the numerous jobs in business and industry would be an uneconomical process entailing much repetition. A better solution is to construct a series of tests which are specific for different abilities. Then, when the abilities which contribute to success in a particular job have been identified, the tests which measure these abilities can be selected from the series and combined in an appropriate battery.

Aptitudes can be successfully measured by two basic kinds of tests. These are *Performance* tests and *Paper-and-Pencil* tests.

Performance tests require the actual manipulation of materials, instruments or tools which bear a greater or lesser resemblance to those the applicant will be required to deal with on the job. This kind of test requires close supervision by a skilled administrator who can usually test only one person at a time. They are often valid, but are impractical and time-consuming methods of selection.

Paper-and-Pencil tests can be either *Verbal* or *Pictorial*. Verbal tests place a premium on the correct use of an extensive vocabulary and the ability to read and comprehend instructions. All verbal tests measure, in a degree, facility with language. Since language facility depends, among other things, upon educational opportunity, the person who has good intelligence but limited schooling is unfairly handicapped when discriminated against on the basis of verbal test scores for jobs which will require little verbal skill.

Pictorial tests, by employing pictures, diagrams, and symbols, attempt to minimize the effect of language facility upon test scores. They are particularly valuable for selecting the more able members of low literacy groups and, from among persons of limited intelligence, those with special aptitude for mechanical or routine precision work.

Characteristics of Good Aptitude Tests

Every good aptitude test, whatever its kind, has these characteristics:

(1) *Validity.* This means that a relationship exists between ability to do well on the test and ability to do well on the job, as measured by output, absenteeism, accident and sickness immunity, supervisory rating, and/or other available criteria.

(2) *Reliability.* A test should measure consistently. A reliable test, given twice to the same group of people, ranks them in approximately the same order each time. So that reliability may be high, the factor of *chance accuracy* must be reduced. A good test is conducted to decrease as much as possible the subject's chance of making a high score by guessing.

In many standard tests, both verbal and pictorial, problems are so presented that solution requires the choice of one item, which bears a certain relationship to a designated item, from a number of possible choices. For example, a test problem may be presented thus:

12 7 20 21 17 19

If the subject cannot add, he still has one chance in four to be correct.

In the series of occupational aptitude tests developed at Illinois Institute of Technology, the factor of chance accuracy is in most cases reduced by requiring the subject to choose, from a series of four or five units, a *pair*, each unit of which bears a previously explained relationship to the other—equality, synonymity, similarity of principle, etc. The chance of choosing a correct pair from four items by guessing is one in six and the chance of choosing a correct pair from five items is one in ten.

(3) *Range.* The test must be so constructed that the range of score from low to high is wide enough to differentiate clearly among people with little, average, and high ability. Table I shows the wide range of score obtainable from well designed tests, even when administered to a relatively homogeneous group.

(4) *Independence.* Ability to score on a particular test must be relatively independent of ability to score on other tests in the same battery. It is obviously a waste of time to include in a testing battery two tests which measure the same aptitude or two aptitudes which vary together so consist-

Table II

PERFORMA TO ILLUSTRATE TEST SCORE PATTERNS

NAME Doe, Jane		TESTS												
		1	2	3	4	5	6	8	10	11	13	17	18	19
RAW SCORE RIGHT		24		25					15	27				
RAW SCORE WRONG		12		4					2	5				
PERCENT OF ACCURACY		67		86					88	85				
PERCENTILE		31		7					17	41				
EMPLOYEE TEST SCORE PATTERN														
ROUGH RANK		5		3					3	6				
JOBS	Labor Grade	JOB TEST SCORE PATTERN												
OFFICE File Clerk	1	4		2					3					
Stenographer	3	5		4					4	5				5
Secretary	5			6	5				6	7		7	5	
Bookkeeper	5			5	4				5			5	8	
MAINTENANCE Sweeper	1		2					2						
Helper #5	3		6			3	5	5	3		3			
Carpenter	5		7			5	6	7	3		4			
SUPERVISORY A. Foreman	II	5	6	4	3		6		6		6			
Foreman	III	5	7	5	5		8		7		6			
Gen. Foreman	V	6	8	6	7		8		8		7			

Job Test Score Patterns represent the minimum Rough Ranks acceptable for the specified jobs. According to her test score pattern, this employee would be acceptable as a file clerk, but a poor risk for any higher level of office employment.

ently that the presence of one may be inferred from the presence of the other.

(5) *Brevity.* An aptitude test should tell an employer what he *needs to know* about an applicant in the shortest length of time consistent with accurate appraisal. Five minutes is usually sufficient, but at the outside, no single aptitude test should require more than ten minutes of an applicant's time. An employer does not want to make a clinical study for the purpose of diagnosis and therapy. He wants to know whether or not there is a good chance that the person can do the job.

Uses of Aptitude Tests

The main uses of aptitude tests are:

(1) To select new employees who have no familiarity with the job for which they are to be hired, but who can acquire the necessary proficiency with a reasonable amount of training. Appropriate tests disclose the degree of ability to acquire skill for the job.

National statistics show that training investments for office clerks or apparatus repair men range upward from $200. Training an insurance salesman may cost $6000. Objective tests tell the employer whom it is worth while to train. They obviate a high percentage of rejects after expensive training, or after a few weeks in service, during which much damage may have been done the good name of the company. Good selection of trainees ensures a work force with pride in its job, its company, and its standards. Today, service is the most priceless possession a company can boast.

(2) To select new employees who already possess familiarity with the job. Appropriate tests disclose the degree of skill.

(3) To assess current employees in terms of their aptitude for the work in which they are engaged; the advisability of transfer to work better suited to their latent abilities; their potentiality for promotion.

It is sometimes argued that aptitude tests are only of real use in relatively large and impersonal organizations which employ hundreds of people and in which the rate of turnover is high. Testing programs are of equal value in small companies employing less than a hundred people and having a low rate of turnover. In such companies methods of rating employees are usually subjective, and valid comparisons of employees with each other and with outside standards are difficult. The personal element is overemphasized, to the detriment of the undertaking. The introduction of an objective and impartial method of evaluation, such as an aptitude testing program, makes it possible for the manager of the small concern to compare his personnel with that of other organizations and to determine whether its calibre is a handicap or an advantage.

Tests enable the work force, however small, to be dealt with justly and economically. They eliminate prejudice, guessing, and temperament. They ease the embarrassment of dealing with the employee who has been retained because of endearing rather than useful qualities. They minimize the personal element where it is most disadvantageous: that is, where it hinders objective evaluation of men according to their abilities.

Evaluation of Personnel

The scientific evaluation of personnel by tests includes these steps:

(1) Analyisis of job to determine the abilities required for job success.

(2) Selection or adaptation of tests designed to measure these abilities.

(3) Administration of the selected tests to personnel on the job to determine the predictive value of the tests. Scores are analyzed and compared with all available data on job success. (output, freedom from accidents, absenteeism, etc). If the initial

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DIONYSIUS LARDNER:

Purveyor of Useful Knowledge

"I have been writing three lectures on Natural History," wrote Ralph Waldo Emerson to his brother, William Emerson, on January 18, 1834, "and of course reading as much geology, chemistry and physics as I could find. A beautiful little essay is Playfair's on the Huttonian Theory. A very good book is Curvier's on the Revolutions of the Globe. . . And the Lardner books and the Family Library furnish some very good reading."

Should one look for that phase of early Nineteenth Century culture which most clearly expressed the dynamic Romanticism of the 30's and 40's, one would find it in eager pursuit of useful knowledge. Not only was there a phenomenal development of the formal institutions and techniques for learning: public schools, colleges, societies of natural history, botanic gardens, museums, and libraries: there was also an amazing impulse for self-teaching. Everywhere, young men and women were digging into the available sources of self-instruction, as Emerson was doing, to acquaint themselves with the realm of natural phenomena and with the historical development of man and his social organization.

There were many who made a business of providing the materials for those who would teach themselves. Of handbooks, guides, compendiums, cyclopedias, and cabinet libraries there was no end. There were books on natural science, mechanics, navigation, agriculture, horticulture, landscape gardening, architecture, astronomy, phrenology, and animal magnetism—all designed for the novice, the untrained but ambitious person who hoped to rise in the world. This was an era in which he who could read could learn; he could learn without the intellectual midwifery of the "correspondence school," a later and questionable development.

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The "Lardner books" to which Emerson referred were typical of this desire to find and collect, to assimilate and disseminate "useful knowledge." Dionysius Lardner, the man from whom they got their name, was one of the most effective popularizers of scientific information in his time. In this day of "Mathmatics for the Millions" and "Science for Everybody" it behooves us to give more than a cursory nod to one of the begetters of the assembly-line method of purveying useful information. It is just possible we may discover that, even in the field of scientific popularization, there is little new under the sun; the subject matter may have changed, but the technique of presentation is much the same.

Dionysius Lardner was born in Dublin, Ireland, in 1793. His Irish origin, at a time when the Irish were not considered one of God's chosen nationalities, was to be a constant source of slander and misrepresentation. As became the son of a solicitor, he was educated at Trinity College, Dublin, where he earned the degrees of B.A. in 1816, M.A. in 1819, and L.L.D. in 1827. He also took orders which admitted him to the title of "Reverend." That he was more than an ordinary scholar was made evident when he took prizes as an undergradu-

Caricature of Dionysius Lardner by William Makepeace Thackeray, one of Lardner's most vituperative critics. The drawing is reprinted from Miscellaneous Papers and Sketches by William Makepeace Thackeray, Houghton, Mifflin and Company, Boston and New York, 1889.

by MENTOR L. WILLIAMS*

ate in logic, metaphysics, ethics, mathematics, and physics. His superior ingenuity was demonstrated by his use of large scale sectional models of machines in a series of lectures on the steam engine delivered before the Dublin Royal Society. For this innovation in the methods of popular demonstration he was awarded a gold medal.

Immediately upon graduation he began to write on technical subjects for the *Edinburgh Review*. For the *Encyclopaedia Metropolitana* he prepared an elaborate article on algebra. His *Elementary Treatise on the Differential and Integral Calculus* (1825), *An Analytical Treatise on Plane and Spherical Trigonometry and the Analysis of Angular Sections* (1827), and *The First Six Book of Euclid with a Commentary* (1828) became standard works and were reprinted for years. In 1827 the young scholar was appointed to the professorship of natural philosophy and astronomy at the University of London. There, in 1829, he gegan laying plans for the great work through which he was to become famous, *The Cabinet Cyclopedia*.

With almost uncanny shrewdness, he secured the services of the best informed scholars to prepare the separate volumes of his cyclopedia. For his monumental series, 133 octavo volumes, completed in 1849, Walter Scott wrote on Scotland, Connop Thirlwall on Greece, de Sismondi on the Roman Empire and the Italian Republic, Thomas Moore on Ireland, James Mackintosh on England, Robert Southey on English naval heroes, John Forster on British statesmen, and Mary Wollstonecraft Shelley on French litterateurs and men of science. Baden Powell and Sir John Herschel wrote on natural science and astronomy, Augustus De Morgan on probabilities, William Swainson on Zoology, John Phillips on geology, John Henslow on botany, and David Brewster on optics. This would be a distinguished list of scholars and scientists in any man's *Who's Who*. Lardner, himself, prepared for the *Cabinet Cyclopedia* the monographs on hydrostatics, pneumatics, history, arithmetic, and geometry, and collaborated on the subjects of mechanics (with Henry Kater) and electricity, magnetism, and meteorology (with Charles V. Walker). And that was not all: there were volumes on brewing and distilling; volumes on the manufacture of iron, steel and other mineral products, of porcelain and glass, of silk; volumes on chemistry, malacology, and taxidermy! It was truly a cabinet library—inclusive and comprehensive. There is no way of measuring the impact it had on the English speaking world; one thing is certain, ignorance could not thrive in its presence.

Few men of letters could escape the vortex of political controversy in the England of the Corn Laws, the Reform Bill, and *Tracts for the Times*. Dr. Lardner, a Utilitarian, an ardent liberal, and a reformer, at once drew down the wrath of the most vitriolic Tory periodical of the day, *Fraser's Magazine*. *Fraser's* reviewers, anti-Utilitarian and anti-liberal, led by William Maginn, a rabid Irish Tory, took savage delight in damning the little doctor to editorial perdition. Upon the appearance of three volumes of *Cities and Towns of the World* (part of the Cabinet Cyclopedia), the assigned reviewer charged that they were manufactured with scissors and paste from guides and gazetteers (as they may well have been). "There is not an iota of information, beyond what is to be met with in the commonest compilations on the subjects, to be found here. After all we will not part unkindly from a volume that combines for us the *utile* with the *dulce;* so long live the gentle Dionysius, and long flourish the noble and gentle craft of CABBAGE AND BOOK-MAKING!" [*Fraser's Magazine*, Vol. II (August, 1830). P. 61].

Two years later *Fraser's* published a cartoon and squib on Lardner in its "Gallery of Literary Characters." In it the uncharitable author quipped: "We find him, on arrival, at once a Professor in the University of London, called by its ill-willers, Cockney College, or some other name still more unsavoury. Here he, with the true spirit of an Hibernian, threw himself, without delay, into the thick of the thousand-and-one fights with which that most pugnacious of universities immediately on its creation abounded, armed, shillela in hand." He soon quit this prize-ring, however, and became "a literary cab-driver, and has started his Cycloped with various fortune, good or bad." [*Fraser's Magazine*, Vol. V (July, 1832), P. 696.]

Of the Fraserians, none was more waggish and mean-tempered than William Makepeace Thackeray: snob, artist, and political satirist. For *Fraser's* Thackeray created "Charles Yellowplush," a serving man with a literary turn, whose observations on life and manners were a sensation in the journalism of that day. In one of the "Yellowplush Papers" Thackeray mercilessly derided Dr. Lardner and Bulwer Lytton, the Whig novelist and a friend of the doctor. In the popular "humorous" orthography of the period Thackeray sneered:

Suffiz to say that the two littery genlmn behaved very well, and seamed to have good appytights, igspecially the little Irishman in the whig, who et, drunk, and talked as much as ½ duzn. He told how he'd been presented at cort by his friend, Mr. Bulwig, and how the Quean had received 'em both, with a dignity undigscribable; and how her blessid Majisty asked what was the bony fidy sale of the Cabinit Cyclopaedy, and how he told her that, on his honner, it was under ten thowsnd. . . .

"Pray, Doctor Lardner," says a spiteful genlmn, willing to keep up the littery conversation, "what is the Cabinet Cyclopaedia?"

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How Foreign Policy Is Made

by ROYDEN DANGERFIELD*

(This article is a condensation of a talk given by Professor Dangerfield before Illinois Tech students February 25 as one of a series of civic education lectures sponsored by the National Foundation for Education in American Citizenship.)

THE conduct of foreign relations has been a troublesome one for democratic governments.[1] Recently Secretary of State Dean Acheson explained "why diplomatists become dipsomaniacs" by pointing to the conflict between the concept of freedom of the press and the need for secrecy. Both the press and radio tend to "tell all," whereas the diplomat finds negotiation impossible if the foreign negotiator shares his secrets.

In a democratic state it is essential that machinery for the conduct of foreign policy assure that decisions when made reflect the desires and protect the interests of the state. which, in a democracy, means the people. All democratic states have been faced with the problem of devising machinery which permits wise decisions in the field of foreign policy and at the same time guarantees popular control. Harold Laski pointed out that "no democratic people has yet satisfactorily solved the problem." He added, however, that "it can at least be said that nowhere has a more careful effort been made toward that end than in the United States."[2]

By its very nature the formulation of foreign policy is an executive function. Even in such a well established parliamentary system as that of the United Kingdom provision is made for little legislative participation in the shaping of foreign policy. The development in the United States has been uniquely different.[3]

The Constitution granted to Congress powers in the field of foreign policy; the power to declare war, to regulate foreign commerce, to lay and collect taxes. It assigned to the Senate a role in the making of treaties and in the appointment of ambassadors, ministers and consuls. The decision to assign such powers to the legislature stemmed from the experience of union under the Continental Congress and the Articles of Confederation.

The more important reason the Senate was given a role in treaty making was the fear of the members of the Convention of an autocratic executive who might by use of the treaty power impinge upon the rights of the state.[4] During most of the time the Constitutional Convention was in session, the treaty power was assigned exclusively to the Senate. And yet there was a feeling that the conduct of foreign relations, by its very nature, was an executive function. In the end this view prevailed and the President was associated with the Senate in the making of treaties.[5] Effort was made to include the House of Representatives in the treaty-making process; but the need for secrecy was recognized and an overwhelming majority rejected the proposal.[6] Time and again in the convention it was pointed out than an important motive toward the union of the states was the desire to preserve the right of navigation on the Mississippi and the New England fishery rights. It was feared by many that under the treaty power these might be bargained away. The west wanted to retain the rights of navigation and the New England States regarded the fishery rights as sacred. To protect the states, the Convention finally inserted the clause requiring a two-thirds majority in Senate approval of treaties.[7]

Fear of Executive usurpation caused the drafters of the Constitution to place the war-declaring power in Congress; recognition of the need for secrecy and dispatch and apprehension that Executive control might jeopardize the rights and interests of the State, prompted them to divide the

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[1]de Tacqueville, in *Democracy in America* stated that "Foreign politics demand scarcely any of those qualities which a democracy possesses; and they require, on the contrary, the perfect use of almost all those faculties in which it is deficient."

[2]Harold J. Laski, *The American Presidency*, (1940) p. 166.

[3]A. C. F. Westphal, *The House Committee on Foreign Affairs*, (1942), Chap. I.

[4]J. M. Mathews, *The Conduct of American Foreign Relations*, (1922), p. 131.

[5]Royden Dangerfield, *In Defense of the Senate* (1933) Chap. I; George H. Haynes, *The Senate of the United States*, (1938) Vol. II, pp. 573-575.

[6]Ivan M. Stone, "The House of Representatives and the Treaty-Making Power," *Kentucky Law Journal*, Vol. XVIII, p. 219.

[7]R. E. McClendon, "Origin of the Two-Thirds Rule in Senate Action upon Treaties," *American Historical Review*, Vol. XXXVI, 768-772; cf. Charles Warren, "The Mississippi River and the Treaty Clause of the Constitution," *George Washington Law Review*, Vol. II, 271-302.

British Foreign Secretary Ernest Bevin affixes his signature to the North Atlantic Defense Pact in historic ceremonies in the Departmental auditorium as British Ambassador Sir Oliver Franks (left) and John W. Foley of the state department's treaty affairs division watch. Behind them, on stage are (left to right): President Truman; Secretary of State Dean Acheson; Lester Pearson, secretary of state for external affairs of Canada; French Foreign Minister Robert Schuman, and (behind Schuman) Ambassador Hume Wrong of Canada. (Picture by courtesy of International News Photos.)

treaty-making power between the President and the Senate.[8]

Despite historic dispute over the question, no one today challenges the primacy of the President in the conduct of foreign relations. His position is by no means impregnable and his range of action is not unlimited, but the initiative lies wholly in his hands.[9]

The supremacy of the executive in the control of foreign relations results primarily from the exercise of general administrative power; the accumulation of information, which is accessible to him but not to Congress; the actual conduct of negotiation; the control over communications with foreign states; the power of recognition; and the actual formulation of policy. The President, as chief executive and as spokesman for the nation, gradually has acquired powers in the field of foreign policy which were not expressly assigned him by the Constitution.

The President is free to consult with whom he wishes concerning foreign policy. Informal advisers may include members of his family, his friends, leaders of his party; such advisers have no legal status but their influence may be great, nevertheless.

The formal advisers of the President include the large group of officials in the executive branch whose primary duties include participation in the formulation and execution of foreign policies. Advice is given by a large number of offices, agencies and departments.

The importance of the Cabinet in the formulation of foreign policy varies with the use the President makes of it. Since most important foreign policy matters today have ramifications affecting more than one department, the Cabinet has great potential significance as a coordinating agency in the field of foreign policy.

The executive office of the President includes the White House office (made up of secretaries and assistants to the president, the "special counsel to the President"), the Bureau of the Budget, and the Council of Economic Advisers. The importance of these officials in policy making varies with the degree to which the President relies upon them for advice.

Within the executive branch, the Department of State and the National Military Establishment play very important roles in the making of foreign policy.

Department of State

The Department of State is concerned almost exclusively with activities relating to foreign policy; it is charged by law with the duty of advising the President on matters of foreign relations. The secretary of state is in close personal contact with the President and keeps the latter fully informed with regard to developments in the foreign relations field.

Immediately under the secretary of state is a body of subordinates—the most important being the under-secretary of state, six assistant secretaries of state, the counselor, the legal advisor, and the special assistants to the secretary. Also attached to the secretary's office is the policy planning staff.

With the new position of the United States in the world, every foreign policy decision made by this country affects a major portion of the world's *(Please turn to page 52)*

[8]James Frederick Green, "The President's Control of Foreign Policy," *Foreign Policy Reports*, April 1, 1939.

[9]L. H. Chamberlain and R. C. Snyder, *American Foreign Policy* (1948), p. 29; see also Blair Bolles, *Who Makes Our Foreign Policy*, (1947).

PLEASE PRINT PLAINLY!

by OTTO EISENSCHIML*

(This article is an excerpt of a talk given before the Chicago chapter of the American Institute of Chemists on April 15, 1949.)

APPLICATION blanks, I believe should be designed to give, when properly filled out, the truest picture of the applicant that can be obtained without an oral interview. The questions asked of him should be pertinent without intruding unduly on his privacy or hurting his pride. After studying a number of application blanks now in use by chemical firms, I find that they seldom, if ever, meet these specifications and therefore do not fulfill their real purpose.

I see no objection to questions pertaining to statistical data. Age, height and weight might well be stated, although I can see little sense in the latter two. Military and scholastic records, extra curricular activities, and the extent to which the applicant supported himself while at college furnish pertinent and legitimate information, but why ask him the number and ages of his children, of his brothers and sisters, and his religious inclinations? Whether his father is alive and what his occupation is? Whether his wife is employed and how? Whether he owns his house and furniture? What possible bearing can all this probing have on either the character of a man or on his ability to perform his duties?

On the other hand, some important questions are not on any of the blanks which have come to my attention. To my mind they are much more pertinent—and less impertinent—than many of those cited.

Have you inventive genius?

Have you original ideas aside from those pertaining to chemical problems?

How long can you work continuously without a break-down?

How do you react to a dead-line? If some work must be finished at a certain time, are you stimulated by this prospect or do you panic?

What do you do when mentally tired? Play Golf? Cards? Read?

Perhaps the most important part of the application blank should be a space left open for a self-portrait of the applicant. Here the chemist should picture himself with scientific accuracy and without fear or favor. It might read like this.

"I am an average chemist, with a good knowledge of chemistry, but with little inventiveness. However, I am a plodder and work on problems put before me with bulldog tenacity. My batting average for solving them is high.

"I cannot work when someone looks over my shoulder and constantly asks me how I am coming along. When I get tired, I must take time off, maybe a day, maybe two. I then go for long walks, and when I come back, I work with greatly increased speed and efficiency.

"My reports are clear and concise, and I can write two kinds: one in chemical terms for my professional superiors and one in layman's language for the front office.

"When I am through with my problem, I require a rest period before I start on a new one."

If application blanks were made to carry such portraits of applicants they might be almost as useful as a personal interview.

When two men meet to transact business it is unthinkable that one of them should introduce himself while the other remains silent. Why then should the prospective employee be the only one to do the talking? Is not he, too, entitled to have some questions answered, such as these:

What is the company's financial standing?

Is there a pension fund and, if so, how much does the employee contribute?

How about health and accident insurance?

What salary may he expect after five years if the employee's service is satisfactory?

What kind of contract is offered, if any?

What is the company's attitude toward attendance to scientific meetings?

Will the employee have a chance to work out ideas of his own?

Answers to the queries chemists have in mind could be embodied in a little folder which should be handed to every applicant. Additional questions should be encouraged, provided they are pertinent.

I suggest that a committee of chemists be appointed to work out a uniform application blank. I further suggest that this committee submit a tentative form to directors of research, individual enterprisers, superintendents and personnel managers. I see no reason why the interested parties should not be able to meet on common ground, work out a form agreeable to all, and thereby contribute toward a better understanding between chemists and those who employ them.

Looking at this matter of application blanks in a broader sense, let me

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*Owner and president of the Scientific Oil Compounding Company, Inc.

Home Fires...

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room is one of the most important danger spots. A link should be placed on the ceiling two or three feet in front of the furnace. If there is a combustible partition near the furnace or near the flue, a link should be placed on the ceiling near the partition. If there is a coal bin, a link should go on the ceiling inside the bin, either over the door or over the side of the bin toward the furnace. If any other combustible material is stored in the basement, there should be a link on the ceiling above it. A storeroom, for example, is a likely location for the start of a fire. If there is a gas water heater, a laundry stove, or a kitchen range in the basement, links should be placed where the heat from a large fire would soon strike them. Any large basement room, even just a recreation room or one with practically nothing in it, should have several links on the ceiling. Though a fire may seem unlikely under these conditions, one in the basement could be so disastrous that all possible precaution should be taken. As a final safety measure, one link should be put on the ceiling just above the foot of the stairs leading up from the basement and another on the ceiling at the head of the basement stairs.

On the first floor every room, except possibly the dining room, needs at least one link. The kitchen should have one near the range, either on the ceiling or on the wall. If there is a utility room, there should be a link in it over the door. If there is a fireplace, it is very desirable to have a link somewhere near, preferably on the ceiling. Curtains and drapes are usually highly inflammable; many serious fires have begun with them. The rest of the rooms might have links inside the room, over the entrance door or alongside it. There should be one in the entrance hall or over the front door. It would be desirable to have a link in the garage, especially if the garage is attached to the house.

If there is a second floor, there should be a link above the foot of the stairs and another at the head of the stairs. It would be safest, perhaps, to place a link over the door in each room upstairs. It is especially important to have a link in all storerooms and several in the attic; there is often much combustible material in these places and a fire starting there is likely to gain much headway before it is noticed.

In selecting the locations of the links, one should have certain questions in mind: Where are there inflammable materials that constitute a fire hazard? What are the isolated places where a fire could burn a long time and not be noticed? Are there any "flues", such as stairwells, up which flame and smoke are likely to rush? What are the paths of escape? The last point is especially important, for as long as one has a clear path to a door, he can get out. If the entrance hall has a chance to become a mass of flame or if the stair can burn down before the alarm is sounded, the warning may come too late. So even though fires may not often start near the front or rear entrance, it is well, just to be safe, to have the outside doors as well as all stairs and halls guarded. One must also remember that the hot gases from the fire rise. Since the action of the links depends upon the melting of the alloy when it is hit by the hot gases, the links must be above the spots they are to guard.

In the actual placement of the links, one must, of course, consider the appearance of the installation. Most people would not put up with an unsightly object on the ceiling, even if it were there to save their lives. Fortunately, it is generally easy to make the installation very inconspicuous. A strip of brass a half-inch wide is not hard to conceal. In most cases the link should go over a door. Doorways, except plaster arches, usually have a wood trim, and the link will not be too conspicuous if it is screwed to the side of the trim near the top of the door. In some cases it might be impossible to conceal a link over a fireplace, but if there is a molding near the ceiling, the link might be fastened to the top of this. A single wire goes to and from each link, and the wire can be run along moldings, around doors and windows, and along baseboards. Front entrance halls are usually dark enough so that a link can be placed almost anywhere without being noticed. At the back entrance, in the basement, in storerooms, and in the attic, conspicuousness of the installation is usually not a consideration.

For the wiring, the only absolute requirement is that the bell transformer secondary, the relay, and all links be in series. The order in which they are connected does not matter. Some thought given to the wiring layout, however, is well worth the time; proper planning could keep the wire needed at a minimum, improve the electrical circuit, and reduce the labor of installing the wire. It is possible to take the circuit all the way through the house, going from floor to floor by way of the stairs. In some cases, however, it may be more economical to drill through the floor. To go straight through the floor and on through the ceiling below, one needs a long electrician's drill. A small hole very close to the wall can be made quite inconspicuous. This may not be generally advisable, but if the basement ceiling is not plastered, it is usually easy to drill through the floor on the ground story, take the wire back through the hole into the basement, and then bring it back through the floor again at some distant point. Where two links on the ground floor are very far apart, a more direct connection can be made in this way than by taking the wire around doors and

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along baseboard to get from one link to another.

If the system is to work properly, the relay must be correctly selected. The exact specifications depend to some extent on the nature of the total circuit, but generally speaking, any fairly sensitive relay with a coil rating of up to six volts at 60 cycles will be satisfactory. For example, the Struthers-Dunn Type 28XAX079, with a coil rated at 4.47 volts A.C., might be used in most installations. The rated current is only 24.4 ma. at this voltage. In a circuit of this type, where the relay is constantly energized, the cost of the electric power consumed by the relay is only 10 or 15 cents a year. This relay has single-pole, double-throw contacts; one of the stationary contacts is therefore left unconnected.

In general, the greater part of the secondary-circuit impedance is in the relay coil. If the links are carefully wired, the line resistance will not usually be more than a few ohms. It may be necessary to insert a resistor in the line to keep the relay voltage down to the rated value. If the transformer secondary voltage is six volts, the total circuit resistance outside the relay should be about 61 ohms, if the relay referred to above is used.

The operation of the alarm should be tested every week or so. This may be done by loosening the bolt on one end of any link and unfastening the wire. If the alarm is in working order, the gong will ring as soon as the circuit is broken. When the wire is reconnected, the gong will stop ringing. It is not necessary to open more than one link to make the test. It is not necessary to use heat to melt any of the links apart. This would only smoke up the wall and make it necessary to replace the link. It would be well before mounting the links in the first place to immerse one in a pan of water at 170°F. to see that it will fall apart. This will serve to check whether or not the alloy became overheated in the process of making or when the links were sweated together.

The alarm system calls for very little care or attention. Some caution should be exercised during housecleaning to see that the wires are not torn off the wall. When the woodwork is painted, it is advisable to pull out a few of the staples near each link, so that the link can be held out of the way while the paint is applied. There is no harm in getting paint on the wiring, and a covering of paint might help to conceal it. But it is best not to paint the links. Tests have shown that paint on the brass parts acts as a heat insulator and delays the separation of the two parts when they are heated. Whenever the wiring lies along the woodwork, it will not usually be necessary to disturb when repapering the room. Other wiring, passing over areas which are papered, will have to be loosened so that the paper can be dropped down behind it.

One caution is very important. Although a switch is provided to turn off the whole system, it should seldom be used. There may be time when it is necessary to turn the system off for
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(Continued from page 22)

repairs or for another good reason; naturally one would leave the fire gong ringing while he repairs an open circuit But there is that danger that he will turn the system off and think no more about it. The resident should take this matter so seriously that, whenever the switch is off he will feel uneasy until it can be turned on again. This is one reason it is desirable to place the switch in the basement. A switch that is quite accessible is too much of a temptation. If one is awakened by the fire gong and finds the house full of smoke, it does not matter whether the bell keeps ringing or not, so long as the family has a chance to get out. On the other hand, if the gong rings and there are no signs of fire, one can go down to the basement and turn it off while he looks for the trouble. There *may* be a fire after all, even though there are no signs of it at first. When the alarm rings one should, of course, assume that the house is on fire and prepare to leave. If the fire is not obvious, he should look for it, and the basement, it has been stated before, is a particularly dangerous area. With the switch there, it is certain to be checked. If the switch were upstairs, it might be too easy for a sleepy man to treat the fire alarm just as he sometimes does the alarm clock—turn it off and go back to bed.

An examination of the circuit will show just what could happen to throw the system out of commission. There are only three things that might do this. One is an opening in the fire gong circuit. This could be due to mechanical damage to the wiring, a failure in the gong transformer, the blowing of the fuse in the circuit, or a failure of the relay contacts to make a good connection. The test described above will show whether the whole circuit is functioning properly. If this test is made at frequent intervals, one can be reasonably sure of spotting any such trouble. A second possibility is that some or all of the links might become shorted out. If this should happen to all of the link wiring, there would be nothing in the secondary circuit of the 6-volt transformer except the relay coil. Since the rest of the circuit is of very low resistance anyway, the protective fuse would not blow and the relay would remain operated. In that case, melting one of the links apart would not open the relay coil circuit. Here again, if the recommended test shows no trouble, one can rest assured that the links are not shorted out. The easiest way to guard against shorting of the link circuit is to wire it up with a single wire, as described above, and not a pair. The one wire leaves the transformer, going through the house from link to link and back to the relay coil by a different route. This is a much better system than bringing the return wire back along the wire going out, for the farther apart the two sides of the circuit are, the less chance there is of a short. Sometimes the wire from one link may return for a short distance alongside the wire going to the link, but if care is used in stapling the wires down, no trouble should result. The point has already been made that where the two ends of the link circuit come back to the transformer and the relay coil, extra caution is called for in insulating all connections and protecting the wiring against mechanical damage. The third way in which the system can be made inoperative is by a power failure. This is usually of short duration, and as soon as the power comes on again, the circuit automatically starts functioning as usual. Probably the only time when something of this sort should cause any real concern is when the power failure is due to storms. If the lights go out during a thunderstorm, it would be well to be on the alert, because lightning might start a fire before the power comes on again.

An alarm system of the kind described seems to be the best answer to the question: How can the private home owner protect the lives of his family against unnoticed fires? This system is not a cure for such tragedies as the La Salle Hotel fire or any of the many fire-trap tenement blazes that have taken so many lives, but it can help to give the family in a private home a good night's sleep, free from worries of fire.

If the job of installing the system seems too great, perhaps one can interest several neighbors to work together as a team, wiring up each of the homes in turn. The installation is really not difficult, and most men would enjoy it. Indeed they would very probably receive more real satisfaction by installing an effective fire alarm system than by putting in a lily pond or building a knick-knack shelf.

DU PONT *Digest*

For Students of Science and Engineering

TEN UNIVERSITIES TO BENEFIT BY GRANTS FOR UNRESTRICTED FUNDAMENTAL RESEARCH

With a view to stock-piling basic knowledge, the Du Pont Company has announced a program of grants-in-aid for the college year 1949-50 to 10 universities for unrestricted use in the field of fundamental research in chemistry.

The grants-in-aid of $10,000 each are to be used for research that has no immediate commercial goal. The universities themselves are to select the projects in which the grants will be employed, and results of the research are to be freely available for publication.

HOW FUNDS WILL BE USED

Du Pont's purpose in offering the grants is to help insure the flow of fundamental knowledge in science upon which the future industrial development of our country is so dependent. It is intended that the funds be utilized for such expenses as employing additional research personnel or lightening the teaching load of a professor who is eminently capable of research of a high order. They may also be expended for the purpose of obtaining supplies, apparatus or equipment.

GRANTS ARE EXPERIMENTAL

This program of grants-in-aid is largely experimental. However, it is Du Pont's hope, should the program work out satisfactorily, to continue each grant for a period of five years.

Four of Many Outstanding Du Pont Fellowship Winners

STANLEY

MARVEL

WALKER

FAWCETT

Dr. Wendell M. Stanley, at University of California, is Chairman of the Department of Biochemistry in Berkeley and in the Medical School at San Francisco; Director of the Virus Laboratory. Bachelor's degree at Earlham College, 1926; M.S. at Illinois, 1927 and Ph.D. in Organic Chemistry, 1929. Honorary Doctor's degrees from five prominent American universities and the University of Paris. Has received more than 10 medals and awards for distinguished work in chemistry and biochemistry; co-recipient of the Nobel Prize in Chemistry in 1946. Du Pont fellow at Illinois in 1928-29.

Dr. Carl S. Marvel, Professor of Organic Chemistry at the University of Illinois since 1930, received his A.B. at Illinois Wesleyan University in 1915; A.M. at Illinois, 1916 and Ph.D. in Organic Chemistry, 1920; Sc.D. (honorary) at Illinois Wesleyan, 1946. President American Chemical Society, 1945; Director 1944-46. Has received numerous honors such as the Nichols Medal and memorial lectureships at outstanding universities. Du Pont fellow at Illinois in 1919-20. Consultant on Organic Chemistry to the Du Pont Company at present.

J. Frederic Walker is a Research Supervisor on formaldehyde products in the Electrochemicals Department. Trained at Massachusetts Institute of Technology. Awarded Bachelor's degree in Chemistry, 1925; Master's degree 1928, Ph.D. in Organic Chemistry, 1929. Author: "Formaldehyde Chemistry," "Organic Chemistry of Sodium," "History of Chemistry." Du Pont fellow in 1926-27.

Frank S. Fawcett is now doing synthetic organic research with Du Pont's Chemical Department. Received Bachelor's degree in Chemistry, Furman University, 1940; Master's degree, Pennsylvania, 1944; Ph.D. in Organic Chemistry, Massachusetts Institute of Technology, 1948. Du Pont fellow at M.I.T. in academic year 1947-48.

77 DU PONT FELLOWSHIPS MADE AVAILABLE TO GRADUATE STUDENTS

Again in the academic year 1949-50, the Du Pont Company is awarding post-graduate and post-doctorate fellowships to universities throughout the country.

This is a continuation of the company's 30-year-old plan to encourage advanced studies in the fields of chemistry, physics, metallurgy, and engineering.

It is hoped that the plan will continue to help maintain the flow of technically trained men and women who will go into teaching and research work at the universities and into technical positions in industry. Some of them, as in past years, may come to work for Du Pont when they finish their studies, but there is no obligation to do so; fellowship holders are free to enter any field of activity they choose.

> **What Fellowships Provide**
>
> Each post-graduate fellowship provides $1,200 for a single person or $1,800 for a married person, together with an award of $1,000 to the university towards tuition and fees. Each post-doctoral fellowship provides $3,000 for the recipient and $1,500 to the university.

The students and their research subjects will be selected by authorities of the 47 universities participating. In this year's program, 45 of the post-graduate fellowships are in chemistry, 4 in physics, 15 in chemical engineering, 5 in mechanical engineering and 2 in metallurgy. There will be 6 post-doctoral fellowships as an incentive to those who would prefer to remain in academic work in order to obtain additional advanced training in chemistry.

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

Entertaining, informative — Listen to "Cavalcade of America" Monday Nights, NBC Coast to Coast

Sherlock Holmes...

(Continued from page 9)

ment which, like so much of his other work, was to provide a practical means to combat the ills of society. He was truly a researcher in the field of sociology.

As with so many eminent scientists, Holmes was not above using his own person to illustrate a point. He, in the presence of Watson and Stamford, dug a "long bodkin" into his own finger to draw blood which he used while illustrating that his re-agent would be precipitated by hemoglobin to give an infallible test for blood-stains. Watson reports that Holmes' enthusiasm "knew no bounds."

This interest in scientific research was the keystone in Holmes' character. Watson assured Holmes at their first meeting that he would not mind the occasional experimentation in their apartments. Evidently Holmes respected the rights of his fellow lodger for the most part, for Watson reports later that his habits were distinctly not of a character to make him, Watson, regret his decision.

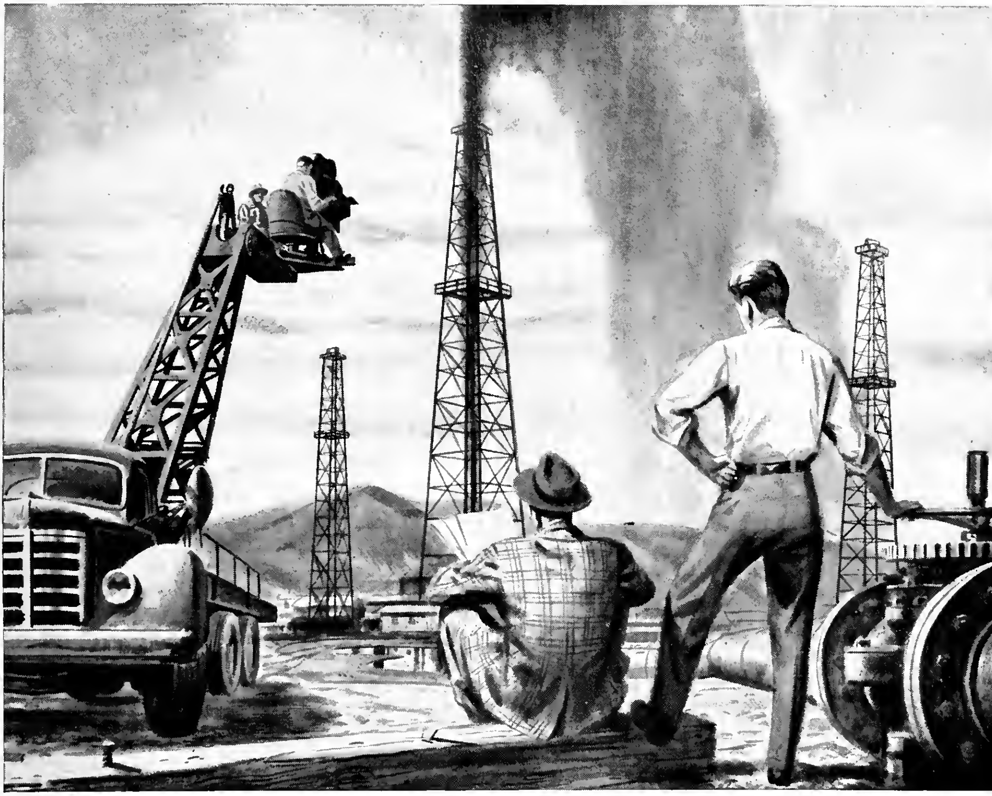
Of course, Holmes did have some very pronounced eccentricities which set him apart from other men. It is the rare individual who pins his correspondence to the wall with a knife, or keeps his tobacco in the toe of a Persian slipper. Watson once made the comment, a trifle petulantly, that their chambers were "always full of chemicals." Perhaps Holmes' researches were of such a character that he could not or did not wish to carry them on in his former haunts.

In the matter of chemistry, Holmes' interest seems to have been largely focused, in the early stages at least, on the organic branch. With his acute sense of analytical reasoning and his ability in the observation of the minutiae, he would naturally turn to the analytical branch of the science.

Watson's writings are replete with vignettes of Holmes in action with scientific research. Holmes in his dressing gown working at his table in the blue light of the Bunsen burner was a sight that etched itself into the doctor's memory. At such times, Holmes' preoccupation with his experiments would be so deep that Watson could come into the room seemingly unnoticed.

With his interest in chemical research, Holmes would have found congenial company among other personalities of history. Watson describes many behavior and personality traits in Holmes which appear to be similar to those of Samuel Johnson as described by Boswell. Even Boswell's first meeting with Dr. Johnson, in Johnson's library, was not unlike the initial encounter between Holmes and Watson. Boswell, on that occasion, "observed an apparatus for chemical experiments of which Johnson was all his life very found." He remarked that his idol, as late as 1782, had found amateur chemistry a means of

(Please turn to page 28)



Methocel goes Hollywood!

Recently the movie people filmed an oil gusher scene, using Methocel (Dow Methylcellulose). This unusual material thickens water, giving a solution which, with the right color added, resembles oil. Why go to such lengths? Because, Methocel solutions are non-inflammable, harmless to actors and are readily washed off with water.

This, of course, is not a vital use of Methocel. But it does indicate Methocel's great variety of applications. Countless industries, including paper, paint, leather, textiles, drug and cosmetics, utilize its widely applicable properties as a dispersing, thickening, stabilizing, emulsifying, binding and coating agent.

Dow research is continuous in all divisions. This is only one chemical of many chemicals vital to American industry and agriculture that Dow has developed.

Dow produces more than five hundred essential chemicals from plants located in Michigan, Texas, California, and Canada. These include major industrial chemicals, germicides and fungicides, agricultural chemicals and "special" chemicals—new products which especially reflect Dow's constant efforts to raise still higher our standards of living.

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DOW

CHEMICALS INDISPENSABLE
TO INDUSTRY AND AGRICULTURE

(Continued from page 26)
mental relaxation after a severe paralytic stroke.

Watson has commented upon Holmes' fastidiousness about his person, and yet remarks that Holmes' hands were invariably stained with chemicals. These hands did not, however, lose their extreme delicacy of touch, and our good friend, Dr. Watson, specifically notes his friend's ability to manipulate fragile instruments.

Holmes' extraordinary success in the application of scientific instruments to verify deductions was of prime importance in recommending their use to Scotland Yard. Holmes himself commented to Watson that one outstanding case, that of detecting a counterfeiter through metallic filings in his cuff seams, made the Yard authorities realize the importance of the microscope in the field of scientific detective work.

While the major portion of Holmes' work was done in the British Isles, he did conduct some experiments on the continent. He did special work on coal-tar derivatives in Montpellier in the south of France. This would mark him as an opportunist in one sense, for these experiments were carried on following the harrowing experience of the Reichenbach Falls affair which was of a character to shake the nerves of a less strong personality.

In a casual aside to Watson, Holmes once commented that his knowledge was of an "out-of-the-way" nature and "without scientific system." His mind, he said, had all sorts of material stored away for reference purposes. The doctor seems to have taken this casual remark for a statement of fact and, in his chosen role of mentor, he mildly criticized Holmes' seeming ignorance in certain fields, particularly that of contemporary literature. Holmes' "naive" inquiry about Thomas Carlyle, to quote the doctor, really emphasized the fact that his "ignorance was as remarkable as his knowledge."

Closer observation of Sherlock Holmes' comments on these points will confirm our opinion that he was pulling Watson's leg. "A man who is able to compare Hafiz with Horace, to quote Tacitus and Thoreau, Jean Paul, Flaubert and Goethe without hesitation, is not a man to be lightly called unread."

Holmes played upon the credulance of Watson in other cases. We may note this in his, Holmes', avowed enjoyment of loafing. He quoted Goethe to the effect that nature had been profligate enough to use up all the material on one man that could have been used to create two—the good man and the rogue. While Holmes may have been at rest physically on occasion, he seems to have been always mentally alerted.

Watson has drawn such a picture of the two roommates at home, Watson reading and Holmes busily engaged with a magnifying glass, studying clues to his latest case or relaxing by deciphering the remains of the original inscription upon a palimpsest. Watson, after several attempts to draw his friend into conversation, would lapse
(Please turn to page 30)

Get a Close-Up OF THE BASIC INDUSTRY OF YOUR CHOICE!

by R. S. FLESHIEM
Manager Electrical Department
ALLIS-CHALMERS MANUFACTURING CO.
(*Graduate Training Course—1904*)

WHEN YOU GET into daily working contact with an industry, you may find it offers specialized opportunites that you hadn't known about before. That's why it's not always possible—or wise—to pick *your* final spot in industry until you've had some all around first-hand experience.

R. S. FLESHIEM

I want to suggest a good way to *get* a close-up of the industries that appeal to you.

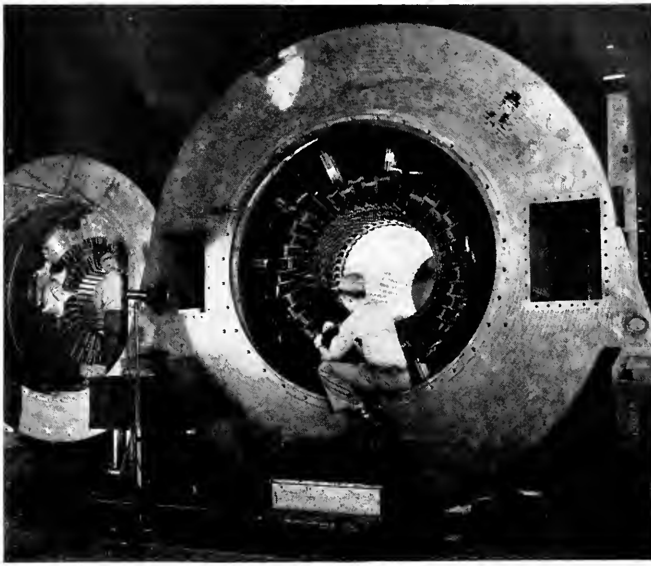
Naturally, I can talk with most assurance about the electric power industry. But the same principles apply to others.

When I got my engineering degree from the University of Michigan, the electric power industry was a fast-growing youngster. I decided to go to Allis-Chalmers, where I joined the company's first Graduate Training Course in 1904. I was sent to Cincinnati and started in the old Bullock Electric Mfg. Co. plant that Allis-Chalmers had purchased that same year. Bullock, incidentally, started in 1884—one of the real old-timers in the electric industry. It was the start of the present Allis-Chalmers Electrical Department.

Opportunities Are Increasing

The industry was growing fast at the turn of the century, but it's growing even faster now. Opportunities were never greater—or more varied.

Studying power and capacity factors in ore crushing, in Allis-Chalmers' complete basic industries laboratory. Camera-recorded data will be applied to commercial mining operations.



Inside View of a hydrogen-cooled steam-turbine generator. A-C Graduate Training Course students may follow important electric power equipment from blueprint to installation.

Today we have Graduate Training Course engineers applying their ability and training to the problems of machine design—research and development—manufacturing and production—sales—application engineering. Here we're working with electric power generation, control and utilization—with advanced industrial uses of electronics—with research in D. C. transmission. We're in intimate touch with the electric power industries—with transportation—with steel, metal working and other big power users. And I know that the field is just as broad in the other major industry departments here at Allis-Chalmers.

What Industry Interests You?

I firmly believe that Graduate Training Course engineers have a unique opportunity at Allis-Chalmers. They have the opportunity here to explore thoroughly not one, but many basic industries if they choose. This company produces the world's widest range of major industrial equipment, and every department is open to the graduate engineer. That includes electric power, mining and ore reduction, cement making, public works, steam turbines, pulp and wood processing. It also includes the full range of activities within each industry: design, manufacturing, sales, research, application, advertising.

Graduate students help plan their own courses at Allis-Chalmers, and they move around a good deal. It's possible for a man to come here with the idea of designing electrical equipment—later become interested in manufacturing—and finally find his greatest satisfaction and success in sales work. Men move from department to department, getting a practical working knowledge of each. And—the departments get to know the men. Opportunities present themselves according to ability.

At the completion of the Graduate Training Course, you've had a close-up of many industries. You're ready to take your place in the work of your choice.

Write for details of the Allis-Chalmers Graduate Training Course—requirements, salary, advantages. Representatives may visit your school. Watch for date.
Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin

A-C ALLIS CHALMERS

ALLIS-CHALMERS

(Continued from page 28)
into grumbling silence and return to his reading.

This situation was not an unusual one for Watson to encounter. Holmes' ability to achieve a complete mental detachment from his surroundings, his talent for divorcing his thoughts from the situation at hand, was something that always excited wonderment on the part of his friend.

One spring morning in Cornwall, while Holmes and Watson were in the course of solving a particularly sinister mystery, Holmes exasperated the doctor by discoursing at some length upon the lore of the kitchen middens of the vicinity. These were things that interested Holmes. He had delved into the folklore of the Cornish people. Their language also claimed his attention. He had propounded the theory that the Cornish folklore was akin to the Chaldean and had been largely derived from the Phoenician traders in tin. His personal library had been augmented, a short time before their departure on the case in question, by a consignment of books upon philology intended to develop his thesis.

Sherlock Holmes, in spite of his reticence about expressing his feelings, took especial pride in the authorship of many monographs on a wide range of subjects and also in the fact that some of his work was being translated into foreign tongues. His works ranged from a discussion on variants in the human ear, which appeared in the "Anthropological Journal," to the essential differences in cigar, cigarette and pipe tobaccos, the tracing of footsteps and the use of plaster of Paris in preserving them for future investigations. He even delved into the study of the tradesman hand and its relationship to its work. A familiarity with most of the then existent secret codes and writings had caused Holmes to prepare a monograph upon 160 ciphers. The great detective also had time to digress into the exotic as witnessed by his writings on the art of tatooing.

All of these works may be considered trifling when compared with the magnus opus of Holmes' career, "The Practical Handbook of Bee Culture, With Some Observations Upon the Segregation of the Queen." Dr Watson has, in his writings on his friend, given many hints as to unpublished works. Holmes had made some investigations into early English charters and Dr. Watson declared that the results of this research was so stimulating that he would publish a full report of them at some future date.

The versatile Holmes had also a love of fine music. There were many occasions when he and Watson went to the theater to hear some outstanding artist. Watson did not have too high a regard for Holmes' ability with the violin, the latter's favorite instrument. If we are to believe Dr. Watson, the great detective was better qualified as a theorist and historian of music than as an accomplished virtuoso.

We are given a word picture of Holmes "returning refreshed to his monograph upon the Polyphonic Motets of Lassus" at the successful conclusion of a case. This paper, when published, was considered by experts to be the final word on the subject. His interest in this particular phase of musical lore is quite in keeping with his general introspective characteristics. Of the motets of Orlando de Lassus we are told, "they are written for voices ranging in number from two to twelve. One cannot play them for they are meant for voices only and would be meaningless if played on instruments. One can. . . . read them and with the ear of the mind, hear their complicated web of sounds."

The accomplishments of Holmes cannot be considered outré. He was in many respects a very methodical man with the keen mind of the scientist and the scholar's appreciation of the arts. He was a man who, in spite of the nervous energy that always seemed to consume him, indulged in periods of lethargy "during which he would lie about with his violin and his books, hardly moving from the sofa to the table." In the congenial surroundings of their Baker Street quarters, outside of which Holmes was uncomfortable, were initiated those feats of reasoning that lead to the extraordinary accomplishments achieved by Sherlock Holmes.

"Madame X" was the code name, during research and development, for an entirely new system of recorded music . . . perfected by RCA.

The remarkable background of **"Madame X"**

Now the identity of "Madame X", the unknown in a long search for tone perfection, has been revealed. From this quest emerges a completely integrated record-playing system—the first to be entirely free of distortion to the trained musical ear . . .

The research began 11 years ago at RCA Laboratories. First, basic factors were determined—minimum diameters, at different speeds, of the groove spiral in the record—beyond which distortion would occur; size of stylus to be used; desired length of playing time. From these came the mathematical answer to the record's speed—45 turns a minute—and to the record's size, only $6\frac{7}{8}$ inches in diameter.

The record itself is non-breakable vinyl plastic, wafer-thin. Yet it plays as long as a conventional 12-inch record. The new RCA Victor automatic record changer accommodates up to 10 of the new records—1 hour and 40 minutes of playing time—and can be attached to almost any radio, phonograph, or television combination. The record *player* ends faulty operation, noise, and cumbersome size. Records are quickly changed . . . RCA Victor will still supply 78 rpm instruments and records.

This advance is one of hundreds growing from RCA research. Such leadership adds value beyond price to any product or service of RCA and RCA Victor.

Continue your education with pay—at RCA

Graduate Electrical Engineers: RCA Victor—one of the world's foremost manufacturers of radio and electronic products—offers you opportunity to gain valuable, well-rounded training and experience at a good salary with opportunities for advancement. Here are only five of the many projects which offer unusual promise:

- Development and design of radio receivers (including broadcast, short wave and FM circuits, television, and phonograph combinations).
- Advanced development and design of AM and FM broadcast transmitters, R-F induction heating, mobile communications equipment, relay systems.
- Design of component parts such as coils, loudspeakers, capacitors.
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- Design of receiving, power, cathode ray, gas and photo tubes.

Write today to National Recruiting Division, RCA Victor, Camden, New Jersey.

Also many opportunities for Mechanical and Chemical Engineers and Physicists.

RCA

RADIO CORPORATION of AMERICA

World Leader in Radio—First in Television

Occupational Aptitude Testing

(Continued from page 13)

selection of tests has been sound, all the tests in the battery will be found to measure some quality which contributes to job success. Only those tests are retained in the final battery which make valid and independent contributions to the selection of good employees. When it is not feasible to administer a trail test battery to the employees in a company, a test battery found to be predictive in similar companies can be used.

(4) Determination of minimum (and sometime maximum) acceptable scores on the tests retained, in the form of Test Score Patterns (explained later in this article).

(5) Routine administration of the selected tests to all applicants for employment.

(6) Selection and placement of personnel on the basis of their scores on the predictive tests.

Test Administration

If dependence is to be placed upon test scores, the conditions under which tests are taken must be standard. The scores of a man who took a series of tests in a noisy room, subjected to distractions and interruptions and instructed by a careless or incompetent administrator, cannot in fairness be compared with scores of men who took the tests under relatively ideal conditions. This is particularly true when there are time limits on the tests and the number of problems solved, as well as the correctness of solution, is an important indication of ability.

These general rules should be followed in all test administrations:

(1) Administer the tests in a quiet room and permit no interruptions.

(2) See that desks or tables, chairs, lighting, ventilation, etc., are adequate and comfortable. Furnish pencils.

(3) Be thoroughly familiar with the tests, so that you can answer immediately and correctly any of the routine questions which are asked by testees while reading the instructions.

(4) Time the tests exactly. This is particularly important in tests whose time allowance is short. Be sure that everyone understands what he is to do before the signal is given to begin and that everyone stops as soon as the stop signal is given. An automatic timer is most helpful.

The Cutting Score

When a final test battery is selected it is routinely administered in the employment office to all applicants. From among these applicants, only those persons are hired who fall within the limits of previously determined *cutting scores.*

At the lower end of the range of acceptable scores is the score which an applicant must reach or exceed if he is to be hired. The cutting score

(Please turn to page 34)

(Continued from page 32)

he is to be hired. The cutting score necessarily depends upon the ratio of individuals hired to those tested. In other words, the more applicants there are for a job, the more particular an employer can be in his selection. So long as a positive relationship exists between ability to do well on the test and ability to do well on the job (validity), the higher the minimum test score required, the better will be the chance of obtaining a superior employee.

The range of ability acceptable in a given job may sometimes be limited at the upper end. It is possible to possess too much of an ability required only in limited amounts for success in a job class. For example, a simple routine job will clearly require a minimum amount of the quality called, for convenience, "general intelligence". A man with too much general intelligence, placed on such a job, is apt to become a dissatisfied and unsatisfactory employee.

Ideally, employees in a job class should possess ability of such a level that the job makes demands neither too great nor too small upon them. Such selection ensures a satisfied and satisfactory employee.

There are available statistical tables that indicate the increase in the ratio of satisfactory to unsatisfactory employees an employer can expect when he introduces an aptitude testing program. To utilize these tables, three things must be known: (1) the validity of the tests; (2) the existing ratio of satisfactory to unsatisfactory employees; (3) the ratio of applicants hired to those tested. Subject always to a sufficient supply of applicants, it is possible by this means gradually to improve the efficiency of a given job class.

Norms

After an applicant has taken a series of selected tests, it is also advantageous to know how the ability he possesses compares to that of other persons. This is determined by evaluating his test scores through previously established averages or *norms*. Tables of norms give the range of possible raw scores and their equivalent percentile scores. Percentile scores are derived from the distribution of raw scores of people of defined status (general population, high school students, employees in specified job classes, etc.) who took the test. The percentile score gives the percentage of persons in the standardized group whose scores are lower or no higher than the given raw score.

For example: If a person answered 39 questions correctly in five minutes on the FIGURES test (No. 3) his raw score would be 39. In order to compare this score with some standard of performance, we refer to Table I, which gives the percentile scores of I.I.T. students on a series of tests which includes FIGURES. The raw score 39 is seen to be at the eighty-fifth percentile. In effect, this means that only 15 per cent of college students solve simple arithmetic problems better.

Whenever possible, the installation of a testing program for the selection of new employees should be preceded by an analyisis of the existing work force. Company norms can then be

(Please turn to page 36)

(Continued from page 34)

calculated and applicants can be evaluated against these names. The employee population in a company may be superior to the industrial population upon which norms were established. Uncritical acceptance of such norms on the assumption that the two populations are truly equivalent may vitiate an otherwise well-planned program. A man who is average according to previously established norms may be well below average in a particular company. Conversely, previously established standards may be too exacting for practical use in a given company.

It is, however, essential to take cognizance of national or localized area norms when an employer wishes to evaluate his overall efficiency in comparison with that of his competitors. He may be able to weigh such tangibles as equipment and wage scales from data already collected. He should also take into account the relative worth of his personnel. Only then will he obtain the complete picture of his fitness to compete.

The "Rough Rank"

In handling and interpreting test results, it is convenient and practical to convert percentile scores into "rough ranks". The precentile score distribution is divided into nine arbitrary intervals, as shown in Table I. The rough rank of a person whose test score equals or exceeds that of 41 through 60 percent of the standard group is seen to be five. He is described as "average". It is thus possible to express the relative standing of an individual in the group by assigning him a number from one to nine. By this method, complex data can be easily handled and coded for business sorting and tabulating systems. Where large numbers of cases are involved or periodic reviews of personnel are made, this simplification of data is essential.

Test Score Patterns

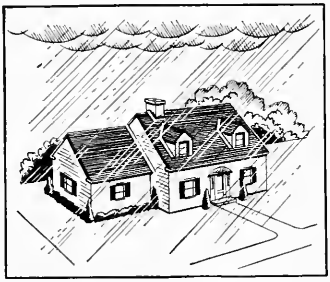
A basic set of tests correlates with performance in any job class group (i.e., direct and indirect labor, maintenance, sales, office, research and executive personnel). Specific jobs with-

(Please turn to page 38)

BUSINESS IN MOTION

To our Colleagues in American Business . . .

A program in which Revere is taking especial interest and pride is that for Revere Home Flashing. The interest is based on sales considerations; we feel that this new product will broaden the market for sheet copper. The pride stems from the fact that through this promotion we are bringing the great advantages of copper flashing to homes whose prices heretofore were not thought to provide for it. This we regard as a valuable public service. Already we have sufficient evidence of sales response and public appreciation to show that the basic idea is sound, and worth pursuing.



For many years the more expensive homes have included copper flashing more or less as a matter of course. Around chimneys, in valleys, over and around windows and doors, wherever there is an opening in the roof or wall, and where one plane meets another, sheet copper is applied as a permanent seal against melting snow, wind-driven rain.

It was partly cost and partly lack of information that was keeping non-rusting copper out of the less expensive houses. As an attack upon the cost problem, Revere conducted a long series of careful tests on various gauges of copper, to see if a somewhat lighter and hence less expensive sheet would do. These tests showed that when properly applied in lengths not greater than four feet, the lighter gauge in a special temper was perfectly satisfactory.

Encouraged by this knowledge, Revere developed a standard package, containing 10 sheets, 18 by 48 inches. Included in each package is a large booklet showing by pictures and simple text how to flash a building correctly, instructions that any builder or carpenter or sheet metal worker can follow. In addition, the package contains hardware bronze nails, so there will be no danger of corroding galvanized nails being used. Two of these packages should be enough to give lasting protection to the average small home, at a price that is within reach. Actually we have a great bargain here, when the cost is compared with the tremendous damage that a single leak can cause to plaster, wall paper, even beams and floors and furniture.

An educational sales, advertising and publicity plan was set up, and is still being pursued. Thousands of homes have been flashed according to this system, homes that otherwise would have been without the protection of non-rusting copper at the vital joints. It would be difficult for Revere to decide which provides the greater satisfaction: sales, or the knowledge that fine copper flashing has been brought to home owners, and for that matter, to builders, who never before considered it within reach.

This is an excellent example of the way in which a search for expanded markets results in increased service to the people. It is thoroughly in the American tradition, for thousands of companies, large and small, have made equal and even greater contributions to our way of life.

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(Continued from page 36)
in a class may require from one to six five-minute tests, depending upon the number of abilities which contribute to job aptitude. Analysis of test results shows how high this relationship is and where the cutting scores for each valid test should be set. These cutting scores are expressed as rough ranks. It is then possible to set up a *job test score pattern* which will express very simply the test performance acceptable for hire in each job in a class.

Similarly, the test scores of each person can be expressed in rough ranks which form an *employee test score pattern.* Matching men and jobs then becomes a matter of matching patterns. The employee test score pattern can be numerically compared with plant job test score patterns and all the jobs which an employee is able to learn can be checked as a guide for future use. When job test score patterns have been determined, clerks can be trained to administer the routine screening tests, score them, and allocate personnel.

Table II shows a typical job test score pattern form. Into it, below the test numbers, have been written the rough ranks obtained by applicant Jane Doe. Since she is being considered only for an office job, she was given only tests which measure clerical aptitude. The minimum rough rank acceptable for a variety of jobs appear printed below the employee pattern. The applicant's rank on each of the five tests in the selected battery is now compared in turn with the cutting rank for each job. Where she equals or exceeds the rank, it is checked. From this evaluation, it can be seen that she is acceptable as a file clerk, but fails to reach the minimum requirements for any higher level of office employment.

Percentage of Accuracy

While the total number of correct answers is the most direct measure of ability, it may be an inadequate measure if it is used as the basis of comparing individuals who have made approximately the same scores. Suppose that two girls are being considered for the same office job and that it is a job in which accuracy and attention to detail are important factors in success. OFFICE ACCURACY (No. 1), a test of clerical aptitude, is included in the test battery given them and both girls make a score of *24* on this test. This places them at the 72nd percentile of department store clerical personnel, as previously determined. On the basis of correct answers, there is nothing to choose between the girls.

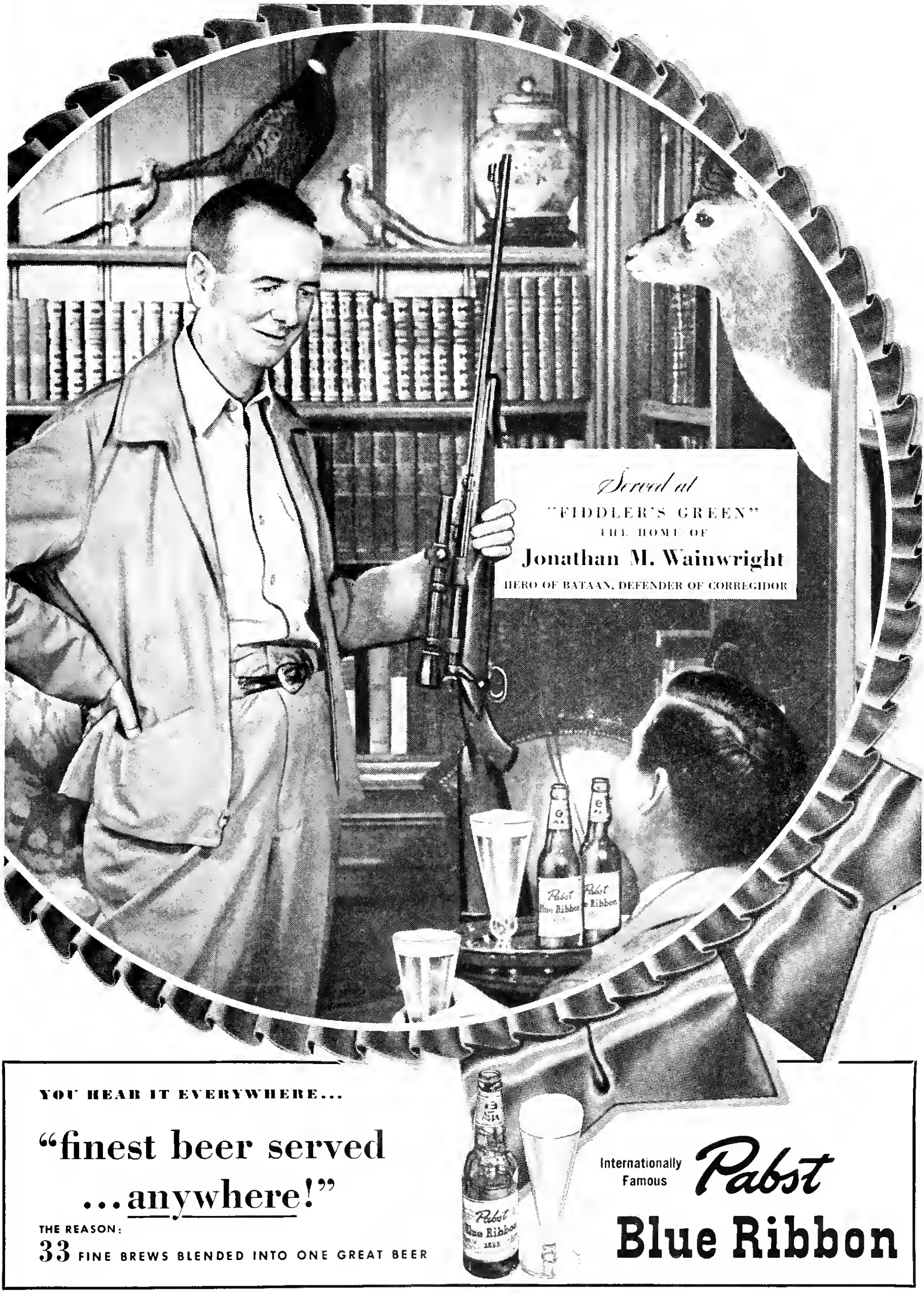
Suppose that Girl A attempted 48 and got 24 right while Girl B attempted 25 and got 24 right. Reference to the Nomograph, Figure 1, shows that the Percentage of Accuracy — Number Right over Number Attempted — of Girl A is 50 per cent. That of Girl B is 96 per cent. If the job in question were to be decided on this test alone, then Girl B would be the better choice as a meticulous and painstaking employee.

Installation of the Test Program

When an aptitude testing program is to be initiated, it is often wise to have the original installation handled by an industrial consultant. Personnel already on the job react more favorably toward an evaluation program introduced by strangers. They may justly or unjustly suspect bias among company officials whom they know. The consultant can be completely objective toward the program. He is unaffected by undercurrents in the company, has neither friends nor enemies. His sole concern is to install a program which will benefit the company and so redound to his own credit.

Finally, the consultant has had varied experience in business and industrial situations. This is an advantage in analyzing job requirements and setting up appropriate test batteries. He is conversant with statistical techniques by which the contribution of each test and the proper weight of each score are correctly determined.

The most logical arrangement would have the consultant work with the company's own personnel officers. He can train them during the installation of the program. When it is operating effectively, they will be familiar with the procedure and carry it on from there.



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33 FINE BREWS BLENDED INTO ONE GREAT BEER
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Dionysius Lardner...

(Continued from page 15)

"It's the littherary wontherr of the wurrld," says he, "and sure your lordship must have seen it; the latther numbers ispicially—cheap as durrt, bound in gleezed calico, six shillings a vollum. The illusthrious neems of Walther Scott, Thomas Moore, Docther Southey, Sir James Mackintosh, Docther Donovan, and meself, are to be found in the list of conthributors. It's the Phaynix of Cyclopajies—a litherary Bacon."

"A what?" says the genlmn nex to him.

"A Bacon, shining in the darkness of our age; fild wid the pure and lambent flame of science, burning with the gorrgeous scintillations of divine litherature—a monumintum, *in fact,* are perinnius, *bound in pink calico, six shillings a vollum."*

The piece concluded with Yelloplush, having been dismissed from his post, consoling himself with the fact that he is about to write a novel in the style of Bulwer Lytton and to prepare "for publigation, in the Doctor's Cyclopedear, 'The Lives of Eminent British and Foring Wosherwomen.' " Thackeray had not done with Lardner, however, for in "The History of Dionysius Diddler" he returned to the attack, this time in a spiteful series of nine cartoons. In Nineteenth Century slang a "diddler" was one who cheated or swindled; it was a good "smear" word.

Meanwhile, Lardner had found another area of interest into which he threw himself with Hibernian fervor. The steamship and the steam locomotive absorbed what energies he was not expending on the *Cabinet Cyclopedia* and on the *Edinburgh Cabinet Library* (38 volumes) which he was editing between 1830 and 1844. Steam had been one of the Doctor's hobbies since his *Popular Lectures on the Steam Engine* (1828). By 1840 that volume had gone into its seventh edition. He kept abreast of the changes and problems in steam railway transportation, reporting his findings in the press and at scientific meetings. At the British Scientific Association meeting in 1837 he read a very effective paper on resistance, acceleration, and gradients in trains and roadbeds. It was published in November of that year in the *Railway Magazine.* The paper was later included with others in a volume, *Reports on the Determination of the Mean Value of Railway Constants* (1842). In 1848, in response to the growing curiosity about steam power, he prepared for the general public *A Rudimentary Treatise on the Steam Engine.* This was followed by a larger popular volume: *Railway Economy, a Treatise on the New Art of Transport, its Management, Prospects, and Relations, Commercial, Financial, and Social; with an Exposition of the Practical Results of the Railways in operation in the United Kingdom, on the Continent and in America* (1850).

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The "Atlantic Steam Question" was one of the scientific controversies of the 1830's. Could a steam-propelled vessel carry sufficient coal and cargo to make such crossings of the Atlantic profitable? By 1836 the paddle-wheel steamers, "Savannah" and "Curacao," had already crossed the Atlantic, partly by sail, partly by steam power. Similar vessels had also sailed and steamed as far as India. Regular service by steam vessels had been established to Spain and Portugal by English shippers. Such coastwise lines, of course, could refuel from port to port. Now the problem was to cross the Atlantic entirely under steam. Could or would ships be built with larger tonnage and smaller, more efficient engines capable of making that voyage?

At the meeting of the British Scientific Association in Dublin in 1836, Lardner made a conservative proposal: that greatly improved steam vessels be built and operated between the west coast of Ireland and Halifax and Boston. He feared that over confidence would lead to rash plans and that the resulting failure would prove a serious setback to steam navigation. Practical considerations, size and carrying capacity of existent steam vessels, he said, dictated such a route. The sail packet lines, he contended, were far more economical for the direct crossings from Liverpool or Bristol to New York. As he feared, several companies began to promote the idea of steamers from England to New York. It was a dramatic notion readily taken up by the general public. When the British Scientific Association met in Bristol in 1837 Lardner condemned the non-stop route as impractical and again urged the adoption of many new devices in engine and ship design as well as the Halifax route. He was accused by the Tory press as having said that an Atlantic crossing was a mechanical impossibility—a slander he was still denying ten years later.

The Great Western Railway Company, incorporated in 1835, hoped to extend its domain by sea from England to the United States. Its 1440-ton ship, the *Great Western*, was already on the ways in 1837 and high hopes were entertained for it. Lardner's strictures were, to the *Great Western* officials, both untimely and unwelcome. The Great Western was completed and outfitted in 1838. Meanwhile, the British and American Steam Navigation Company chartered the 703 ton *Sirius* and refitted it with the first fresh water condenser system to be put into commercial use on the sea. Both companies expected to reap fortune kudos from their ventures. The *Sirius* made the crossing with 100 passengers; the *Great Western* crossed the Atlantic in 15 days. Fanfare over these exploits rose to a high pitch; it seemed that Lardner had been controverted. He had his innings, however, because he could point out seven years later that the British and American Company had withdrawn its boats completely from the Atlantic run, and that the *Great Western*, the sole vessel operated by the Great Western Company, ran

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but one a month and only in the summer season. Samuel Cunard, having wangled a mail subsidy from the British Admiralty, formed the company that was eventually to bear his name and built the steamer *Britannia* which made its maiden voyage in July 1840 from Liverpool to Halifax to Boston in 14 days and 8 hours. The "Halifax line", as the Cunard line was then called, built several sister ships and followed Lardner's advice. But, the economic stability of the line was greatly bolstered by a $500,000 mail subsidy per year!

Without doubt, the political aspects of these economic enterprises played a part in the venomous attacks upon Lardner. The Whigs were again in power; Lord Melbourne was Prime Minister when the Halifax route was proposed and the mail subsidy granted. Lardner wrote a public letter to Lord Melbourne in 1837, "Steam Communication with India by the Red Sea." In 1839 the steamer service to the Spanish peninsula was extended to Alexandria, and the new line was called the "Peninsular and Oriental." It proved unusually profitable and its success no doubt constituted the prologue to that exciting imperial drama of the acquisition of the Suez in which Victoria and Disraeli played the leading roles.

Lardner went to the United States in 1840. The trip was occasioned by the Heaviside scandal. For some time Dionysius, a not inappropriate name for a philanderer, had been having an *affaire de coeur* with Mrs. Heaviside, wife of Captain Richard Heaviside, an officer in a cavalry troop. Lardner, separated from his own wife and three children since 1820, eloped with Mrs. Heaviside in March, 1840. Nothing so juicily sensational had stirred John Bull's island since the Byron affair or the Regency scandal over Queen Caroline; it was a pleasant morsel for the gossip mongers. To assuage his marital honor Captain Heaviside instituted suit charging Lardner with "carnal conversation." Heaviside was awarded the verdict and £8,000 damages. Parliament, by official act, conveniently dissolved his marriage. Lardner, however, was not formally divorced from Celia Lardner until 1849. He then married Mrs. Heaviside by whom he had two children. Obviously Dr. Lardner's fortunes were hard hit; the United States would be a good place in which to recoup $40,000.

By his own statement, Lardner arrived in New York September 29, 1840, "accompanied by his family". After spending seven months in Philadelphia and an equal time in New York, he determined on a lecture tour of the United States to collect and to distribute information, incidentally earning his expenses by the latter. "I had already observed," he said, "that the American public in New York and Philadelphia manifested more than ordinary taste for oral instruction on scientific subjects." Moved by these considerations, he prepared "the necessary means of illustration adapted for large and popular audiences" and began a series of lectures in New York, November-December, 1841. Boston was his host city in January-February, 1842. Philadelphia heard him in March. From then until December, 1844, he lectured in "every considerable city and town of the Union, from Boston to New Orleans and from New York to St. Louis." The lectures

(Please turn to page 46)

ALAN LADD now co-starring in "WHISPERING SMITH", a Paramount Picture. Color by Technicolor.

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We propose to keep on being pioneers in broadening the usefulness of aluminum. Alcoa Aluminum sold in 1939 for 20 cents a pound. It sells today for 16 cents.

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ALCOA FIRST IN ALUMINUM

(Continued from page 44)
were each from two to three hours long and his mixed audiences of all ages ran as high as 2,000. He had enthusiastic attendance in Charleston, Mobile, Vicksburg, St. Louis, Cincinnati, and Pittsburgh—all the learning in America, he found, was not on the seaboard. His discourses were widely reported in the press, some even by shorthand transcription. *A Course of Lectures on the Sun, Comets, The Fixed Stars, and Electricity* (New York, 1842) was the first appearance of his lectures in book form.

That Lardner combined showmanship with instruction in order to achieve such a reception is obvious. His own description of his methods gives us an adequate characterization of the bustling doctor on the platform:

The oral discourses were strictly extemporaneous. . . . They were delivered from the stage of the theatre without any written notes or memoranda. The general outline of the subject, the leading arguments, and the most important illustrations and examples, were previously registered in the memory of the speaker. The language in which these were clothed . . . was left to the suggestion and inspiration of the moment. . . . This course [was] adopted . . . because it was found, from long practical experience in public lectures, to be the best. The style of the speaker is more animated . . . [and he] can adapt his mode of reasoning and style of illustration to the varying character and capacity of his audience. . . . The style of a written essay is like that of a cabinet picture, that of an oral discourse like scene painting. The effect of the one is produced by elaborate finish, that of the other by bold and rough lines which seize the most inattentive and unskilled eye. . . .

[The good public lecturer] must possess such command of his subject, and such fluency of language, as will . . . enable him to speak directly from his thoughts and his understanding, and not merely repeat words which he has previously committed to memory. Clearness and order must be conspicuous in his reasonings, and his illustrations must not only be apposite, but adapted to the character, capacity, and acquirements of his audience. He must be endowed by nature with a voice sufficiently powerful, and articulation sufficiently distinct, to render every syllable he utters easily and immediately audible to the most remote of his hearers, and his manner and appearance must be exempt from any peculiarities calculated to excite repugnance. Such a teacher will be sure to command success with a popular audience, and his labors will be beneficial to his hearers and profitable to himself. . . .

It was usual to extend the evening's entertainment to a length not previously customary with public lectures. From two and one half to three hours was not an unusual length. This time, however, was not devoted to a single subject. A succession of two, three,
(Please turn to page 48)

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and sometimes four subjects, would often be produced, having no connexion whatever with each other. Thus astronomy, electricity, and the steam-engine, would be successively noticed, short intervals of rest being left between them, as between the performances in a dramatic theatre. . . . In the lectures on the steam-engine, I used large sectional models as illustrations. . . . The practice of using round numbers in preference to the exact numerical value [*proved beneficial in the lectures*].

In 1846 a two volume edition of Lardner's *Popular Lectures on Science and Art* was published "for general information and amusement, rather than for purposes of reference or systematic instruction," by Greeley and McElrath, owners and editors of the New York *Tribune.* In their advertisement they remarked, "probably no public lecturer ever continued for the same time to collect around him so numerous audiences . . . . Visit after visit has been made to all the chief cities; and . . . audiences amounting to thousands have assembled to hear again and again these lessons of useful knowledge." By 1852 these *Lectures* had gone through fourteen editions. Lardner was said to have earned £40,000 from the platform—not counting the profits from the sale of the books. Small wonder, then, that the Doctor and Mrs. Heaviside were able to settle in Paris in 1845 and remain there the rest of his life.

Not every American accepted Dr. Lardner at his face value. Edgar Allan Poe satirized him in a popular short story, "Three Sundays in a Week" as Dr. Dubble L. Dee, "the quack lecturer on physics." In one of the "Marginalia" paragraphs, Poe attacked Lardner's explanation of the apparent variance in the size of the sun at the meridian and at the horizon, and claimed that Lardner was "incapable of appreciating metaphysical explanations". Elsewhere, in "The Thousand-and-Second Tale of Scheherazade," Poe cribbed shamelessly from Lardner's 1842 *Course of Lectures.* Legitimate professors of science tolerated Lardner's tour, but did not

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refrain from sarcastic comment when moved to it.

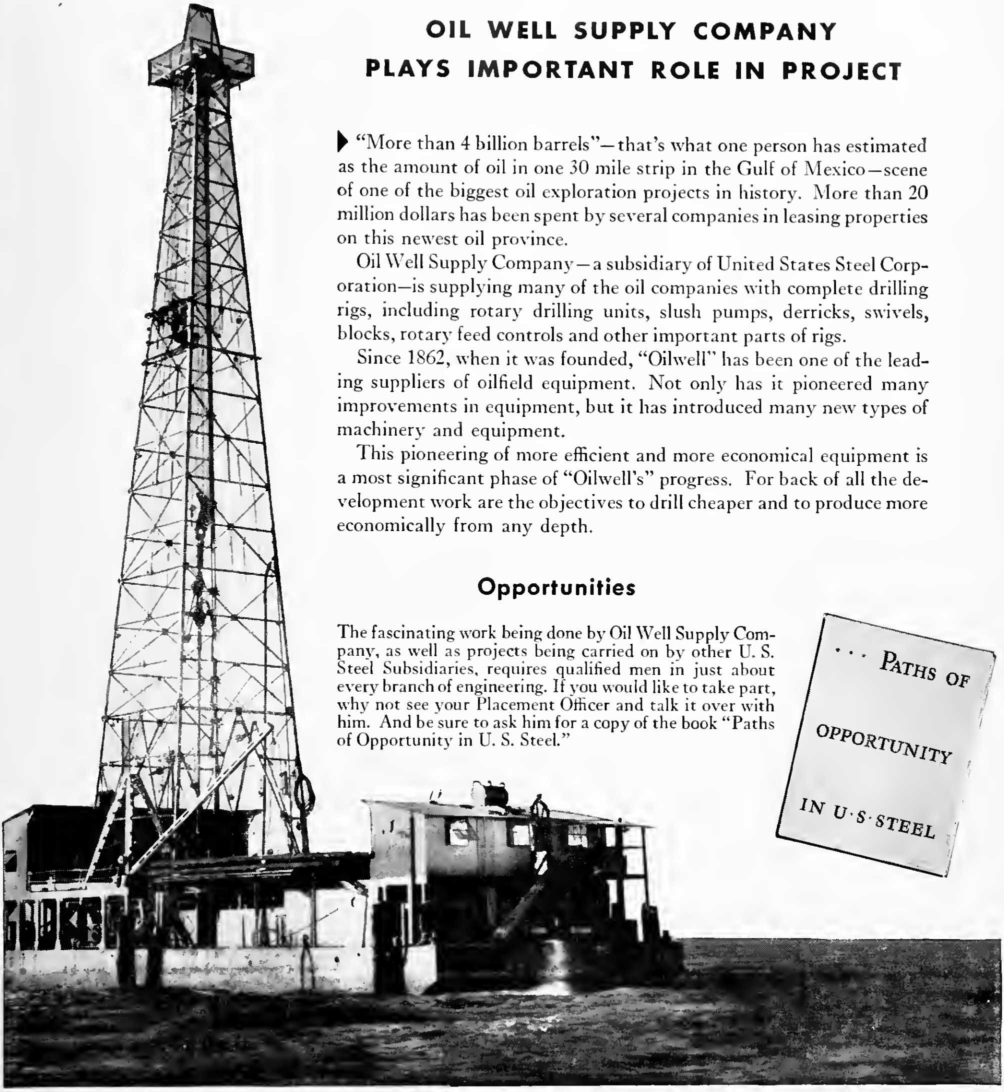
What were the subjects which so entranced the American populace that it was willing to pay $200,000 to hear about them? "The Plurality of Worlds," "The Aurora Borealis," "Halley's Comet," "The Tides," "Galvanism," "Theory of Colors," "Waterspouts and Whirlwinds," "Popular Fallacies," "Magnetism," "Action and Reaction," "Atmospheric Electricity," "Electro-Magnetism," "The Stellar Universe," "The Steam-Engine," to list but a few. Most of these topics were surrounded by contemporary mystery or excitement or controversy which made his discussion doubly interesting. The lectures, to a modern reader, show a mind that possessed no great originality and very little depth; at the same time it is marked by a vitality and versatility that must have carried many an idea to a receptive audience. For the most part his facts were accurately garnered and competently presented.

At the opening of the Great Exhibition in London in 1851, Lardner was invited by the London *Times* to come over from Paris and assess the various exhibits in a series of letters for that paper. To the latest technological advances he gave much attention. He discussed "Artificial Light," "Photography," "The Safety Lamp," "Electro-Metallurgy," "Glass Manufacture," "Railway Machinery," "The *Times* Printing Machine," "The Calico Printing Industry," "The Hydraulic Machinery of the Britannia Bridge," "Whitworth's Micrometer," and Leon Foucault's pendulum, first set up in Lardner's Paris home, to demonstrate the rotation of the earth on its axis. He even got involved in the quarrel over the Erard and Broadwood pianofortes, pronouncing Erard's repetitive key action (double échappement) far superior to the key action of the Broadwood piano.

Lardner renewed his interest in astronomy in 1852 with a series of papers for the Royal Astronomical Society of England. These were followed by *A Handbook of Natural Philosophy and Astronomy* (1853). In the same year he began a series of twelve volumes relating science to everyday life. These were completed in 1856 under the title *The Museum of Science and Art.* One of his most popular works, if reprinting is any criterion, was *Animal Physics, or the Body and Its Functions Familiarly Explained* (1857). *Animal Physiology for Schools* (1858) and *Chemistry for Schools* (1859) appear to have been forerunners of a series cut short by his death in 1859. No complete bibliography of Dionysius Lardner's works has ever been made, but as one thumbs through the catalogue cards in any fair-sized library, this plain truth is driven home:

> *The most obvious means of elevating the people is to provide for them works on popular and practical science, freed from mathematical symbols and technical terms, written in simple and perspicuous language, and illustrated by facts and experiments which are level to the capacity of ordinary minds.*
>
> [Motto on the title page of *Popular Lectures*]

Gulf of Mexico is site of newest oil "boom"



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UNITED STATES STEEL

How Foreign Policy Is Made

(Continued from page 17)

population. Conversely, the problems of any part of the world become our problems. The new importance of foreign policy is graphically reflected in the growth of the department of State.

Historically, the Department of State has been relatively small, compactly organized, and to a major degree self-contained. Today it is a huge and sprawling department with a multitude of activities. In 1790 it consisted of eight officials, including a secretary of state, a chief clerk, clerks, and one part-time foreign language clerk. The growth of the department from that humble beginning was slow. In 1833 the staff totaled 22; in 1870, it had grown to 52 employees. By 1909 the personnel had reached 209 and in 1922 it numbered 631. The increasing importance of foreign policy was manifested when the total personnel jumped to 963 in 1938, 2755 in 1943, 7623 in 1946, 7800 in 1947 and then dropped to 5648 in 1948.[10]. Between 1938 and 1948 the personnel increased 487 per cent. From the point of view of appropriations, the department's growth has been phenomenal. The 1948 budget requests were five times larger than the 1943 appropriations. Between 1938 and 1948 the budget increased 1200 per cent.

Even more significant than growth in personnel and appropriations is the growth in the functions of the department. The economic desks have grown very rapidly in importance. By June, 1947 the total personnel working on economic aspects of foreign policy was almost double the personnel working on the "political desks"—the old core of the Department.[11]

Equally significant has been the growth of departmental activity in the informational and cultural relations. The broadcasting activities of the "Voice of America," the establishment of overseas libraries, the publication of materials on the United States for foreign peoples and the greatly enlarged cultural relations program have required the addition of large staffs. In 1946 Assistant-Secretary of State Benton reported that twice the number of people were working on the informational and cultural program than were employed in the entire department in 1939.[12]

While the growth of the Department of State is indicative of the growth in importance of foreign policy within the government, it is also indicative of the growing complexity of foreign policy itself. Recent developments make it unmistakably clear that the foreign policy of the United States is integrally tied to domestic policy and programs. "Every aspect of life is projected in some way beyond the country's boundaries."[13] According to the Hoover Commission task force, "The traditional line of demarcation between domestic and foreign problems has completely disappeared."[14] Other departments and agencies must participate with the Department of State in shaping foreign policy.

The National Military Establishment

In the world of the present there is a very close connection between foreign policy and military security. It is essential that all aspects of national security be coordinated in such a way that foreign policy reflects security considerations. Realizing this fact, Congress in 1947 passed the National Security Act.[15] This created the Nation-Security Council, the Central Intelligence Agency, and the National Resources Board. The Act also established the Military Establishment, including the Secretary of Defense, the Joint Chiefs of Staff and the Joint Staff, the War Council, the Munitions Board, the Research and Development Board as well as the Departments of the Army, the Navy, and the Air Force.

The National Security Council consists of seven members, the President, secretary of defense, secretary of the Army, secretary of the Navy, secretary of the Air Force, and the chairman of the National Security Resources Board. The Council is charged with the duty of advising the President "with respect to the integration of domestic, foreign, and military policies relating to national security . . ." The Council advises the President on poli-

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[10]See the report of General O. L. Nelson on the "Organization of the Department of State," prepared for the Secretary of State, 1946; the report of Royden Dangerfield on "The Relationships between the Departments of State and Commerce," prepard for the Bureau of the Budget, 1948; The Commission on the Organization of Executive Branch of the Government (The Hoover Commission), *Foreign Affairs*, p. 76; Arthur W. MacMahon, "International Policy and Government Structure," *Proceedings of the American Philosophical Society*, Vol. 92, pp. 217-218.

[11]MacMahon, p. 218.

[12]*A New Instrument of U.S. Policy*, (Department of State Publication No. 2700), p. 16.

[13]MacMahon, p. 127.

[14]Hoover Commission, *Task Force Report on Foreign Affairs* (appendix H), p. 1; cf. Dangerfield, "Relationships between the Departments of State and Commerce, p. 43.

[15]Public Law 253, July 26, 1947.

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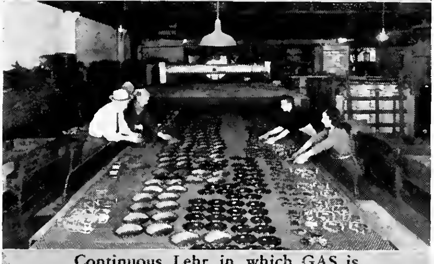

Continuous Lehr in which GAS is used for annealing signal and industrial glass products.

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(Continued from page 52)

cies of common interest to the departments and agencies having to do with national security, and plays a paramount role in foreign policy. The creation of a Security Council changed the whole technique of making important national policy and produced a coherent system in contrast to the squabbles of the past.[16]

The National Security Resources Board, the Central Intelligence Agency, the Joint Chiefs of Staff, the War Council and the Munitions Board all play a role in the shaping of foreign policy. The secretary of defense, who is the principal assistant of the President, plays a very important role in formulating foreign policy. As chief of the Military Establishment he is an important avenue through which the Departments of the Army, Navy and Air Force advise the President.

There are critics who feel that within the past few years the military has come to play too great a role in the formulation of foreign policy.[17] President Truman has been severely criticized for relying too heavily upon the military for advice in policy making. "That there was ground for such criticism cannot be denied, and in fact has not been denied by Mr. Truman's associates." Members of the President's staff have pointed out that in the Security Council, when a controversial matter is under consideration, "the three service secretaries, the secretary of defense, the chief of staff to the President, the director of CIA and the Joint Chiefs of Staff have tended to hold the same view and have greatly outnumbered and out voted the three civilian members . . . the President, the chairman of the National Resources Board and the Secretary of State."[18]

In his first report to the Congress the former secretary of defense, Mr. Forrestal, recommended that the National Security Act be amended to drop three service secretaries from the Security Council.

The Hoover Commission task force recommended that the secretary of defense be the sole representative of the National Military Establishment on the National Security Council.[19] The Hoover Commission went further and recommended the establishment of Cabinet committees to formulate foreign policy and the creation of a staff secretary to see that policy decisions are carried out.[20] If such recommendations should be implemented the position of the National Security Council would be altered.

Other Departments

Because of the complexities of foreign policy and the domestic implications of decisions in this field, other departments play significant roles in policy formulation.

The Treasury Department is concerned with monetary, financial and exchange aspects of foreign policy.

The Department of Commerce participates in the formulation of foreign economic policies. Through the Office of International Trade, the department works with the Department of State and other agencies and with Congress for the purpose of representing the economic interests of the government and the people.

The importance of food and agriculture in foreign policy gives the Department of Agriculture an important position in the mechanism for formulating foreign policy. The department is the principal point of contact of the United States government with the Food and Agricultural Organization of the United Nations.

The influence of the Department of Interior is not great at the present time. Many of the policy functions in fields normally under the control of the Department of Interior have been assigned to the Department of State and Commerce, and these departments have built up considerable staffs to handle such policy problems.[21]

(Please turn to page 56)

[16] Alsop, "How Our Policies Are Being Made," *Daily Oklahoman*, September 24, 1948; see also Helen R. Kirkpatrick, "The National Security Council," *American Perspective*, February 1949, (Vol. 2), pp. 443-450.

[17] See Blair Bolles, "Influence of the Armed Forces on United States Foreign Policy," *Foreign Policy Reports*, October 1, 1946, and "Military Influence on U.S. Foreign Policy Diminishing," *Foreign Policy Bulletin*, March 11, 1949; Chamberlain and Snyder, *op. cit.*, Chapter IX.

[18] Kirkpatrick, *op. cit.*, p. 450; cf. Hoover Commission, *The National Security Organization*, (1949), p. 9.

[19] Hoover Commission, *Task Force Report on the National Security Organization* (Appendix G), (1949), pp. 16. 62.

[20] Hoover Commission, *General Management of the Executive Branch*, (1949), Part II.

[21] Brookings Institution, *Major Problems of United States Foreign Policy*, (1948), p. 226.

(*Continued from page 54*)

The Department of Labor is the United States representative in the Intenational Labor Organization, working through the Office of International Labor Affairs.

There are numerous other agencies of the national government whose work affects foreign policy. The Economic Cooperation Administration is the newest such agency. Created by law in April. 1948, the new administration is headed by an administrator who by law has "a status in the executive branch of the government comparable to that of the head of the executive department." Within the scope of its operations, it is almost a second Department of State.

In all there are some forty-five separate government units participating in the formulation of and execution of foreign policy. The Hoover Commission reports that "few departments and agencies have recast their organization to meet effectively their increased responsibilities in foreign affairs."[22]

Coordination

"*It should be obvious that the executive establishment is so vast and so loosely organized that the formulation of foreign policy requires some arrangements for co-ordinating the activities of the agencies concerned with foreign policy matters. Not only is it difficult to draw a clear distinction between purely domestic and purely foreign problems or between these aspects of one problem, but matters that require the formulation of foreign policy usually have implications, direct or indirect, that transcend the boundaries of a single department or agency. Coordination becomes imperative, whether the problem is one requiring advice or recommendation for a Presidential or other high-level decision, or whether it is one at the departmental level or below.*"[23]

Existing coordinating arrangements include:

1. Coordination by the President, usually as a result of interdepartmental disputes appealed to him.

2. Coordination by the Bureau of the Budget as a result of its interest in improved administrative management and its role in the preparation of the budget.

3. Coordination provided for by Congressional legislation, such as the acts creating the Economic Cooperation Administration, the National Security Council, and the National Advisory Council on International Monetary and Financial Problems.

Under the Economic Cooperation Act the ECA special missions abroad were placed under the Foreign Service of the United States, thus integrating the two services and preventing conflicting policies in the field. The Act also requires a full exchange of information between the administrator and the secretary of state. Should the two be in disagreement, the dispute must be referred to the President for resolution.

The National Advisory Council is an interdepartmental committee composed of the secretary of the treasury as chairman with the secretaries of state and commerce, chairman of the Federal Reserve, chairman of the Export-Import Bank and the administrator for economic cooperation as members. The NAC has a statutory duty to coordinate policy and operations of all agencies to the extent that they make or participate in the making of foreign loans or engage in foreign financial transactions.

4. Coordination by inter-departmental committees established by the President, or by agreements between cabinet members. *The Directory of Committees*, issued by the Department of State, lists nearly forty such committees, in addition to those created by law. Some of these are dormant, their work apparently having been completed. The Hoover Commission task force reported that twenty-seven such committees (in addition to six created by statute) were of sufficient importance to warrant special study.[24] Some of the committees are concerned with highly specialized policy, while others deal with problems covering a wide segment of policy.

The creation of interdepartmental committees has taken place at such a rapid rate it is already evident that "the multiplication of interdepartmental groups with a general jurisdiction will result in further subdivision of activity and in numerous sub-committees."[25] The tendency to subdivide is well illustrated by the example of the executive committee on Economic Foreign Policy, which now has nine sub-committees as well as two techni-

(*Please turn to page 58*)

[22]*Report on Foreign Affairs*, p. 69.
[23]Brookings Institution, *op. cit.*, p. 228.
[24]Hoover Commission, *Task Force Report on Foreign Affairs*, p. 62.
[25]Brookings Institution, *op. cit.*, p. 230.

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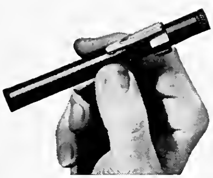

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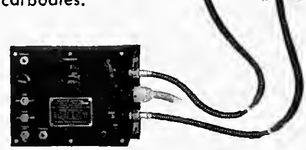

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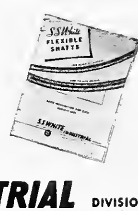

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Contributors . . .

(Continued from page 4)

Group of Chicago. He is also former director of the Chicago Junior Association of Commerce and was selected for the association's "Key Award" in 1941. Previous articles by Mr. Kubicek have appeared in the December 1946 and October 1948 issues of the *Engineer.*

Phil S. Shurrager, professor and chairman of the department of psychology at Illinois Tech since 1946, received his B.S. degree at Muskingum college, his A.M. at Ohio university, and his Ph.D. at the University of Illinois. In addition to experimental work in educational psychology, Dr. Shurrager has taught zoology, physiology and psychology at the University of Rochester, Ohio university, the University of Pennsylvania and St. Lawrence university. The author of a number of articles in the fields of biology and psychology, Dr. Shurrager served as industrial psychologist for a firm of management engineers before joining the Illinois Tech staff.

Mentor L. Williams, associate professor of English at Illinois Tech since September 1946, received his A.B. degree in 1925 and his M.A. degree in 1928 at the University of Washington. In 1938 he was awarded a doctor of philosophy degree by the University of Michigan. He remained at Michigan as assistant professor until 1945. Dr. Williams has also been on the teaching staffs at the University of Idaho and at Toledo and Tulane universities. He has been a frequent contributor to the *Engineer.*

Foreign Policy . . .

(Continued from page 56)

cal committees.[26] "By recent count there were found to be 142 sub-committees or *ad hoc* working groups organized under the 33 interdepartmental committees."[27]

The multiplication of coordinating committees, and their subsequent subdivision, has now reached the stage where it is necessary to coordinate the coordinators. This was recognized by the Hoover Commission when they recommended that

"The work of these committees should be integrated. While they were initially created for some specific purpose, they tend to become permanent and to waste time and personnel."[28] To provide for the necessary coordination the commission recommended the establishment of the position of staff secretary within the office of the President.

The Role of Congress

Despite the fact that executive predominance in the field of foreign policy is well recognized, Congress still plays an important and significant role in the formulation of foreign policy. Foreign policy within recent decades has come to require more and more by way of specific legislation for implementation. Ever more frequently foreign policy requires appropriations. This development increases the power of Congress over foreign policy decisions.

The LaFollette-Monroney Bill, providing for the reorganization of the Congress, resulted in more adequate staffing for the Committee on Foreign Relations and the Committee on Foreign Affairs. These committees are now able to secure information more nearly adequate to the making of decisions, and are enabled thereby to play more important roles in policy formulation.

Two unusual developments of recent date merit mention. The first is the recent developement of joint standing committees — so-called "watch dog" committees—created for the purpose of providing a continuing scrutiny on behalf of the House and Senate of executive agencies. One such committee is the joint committee on expenditures of the executive branch. The joint committee on the European Recovery Program maintains a staff to observe the operations of ECA in carrying out the Marshall Plan.

The second development is one which took place in the Eightieth Congress. The House appropriations committee refused to abide by the decision of the subject matter committees involved and undertook to pass upon policy as well as appropriations. After the committee on foreign affairs, and the House itself, had approved the Marshall Plan, the appropriations committee reopened the whole question of policy. In the initial appropriation of the foreign aid program, the House committee undertook to review a policy already formulated by the Congress. The action of the committee and of the House, which followed the committee recommendation, was later modified as a result of Senate action but not before it had raised doubts abroad as to the intention of the United States.

If the United States is to develop coherent foreign policies then it is necessary that there be close cooperation between Congress and the President. The effectiveness of any such

(Please turn to page 60)

[26] ***Directory of Committees,*** **pp. 11-28.**

[27] **Hoover Commission,** ***Task Force Report on Foreign Affairs,*** **p. 65.**

[28] ***New York Times,*** **February 8, 1949, p. 18.**

(Continued from page 58)
coordination is dependent upon the personalities of the President and congressional leaders, and upon the political relations between the two branches of government.

The bi-partisan foreign policy is a carry-over from a war-time truce. At the same time, it is the response to a very nervous world situation. There are indications that bi-partisanship is dying and we may be entering a period of partisan strife in the field of foreign affairs.

Conclusion

The mechanism for the conduct of foreign relations has grown increasingly complex during the past decade and the post-war years have added burdens which have tended to complicate the problem. Events have made inadequate the pre-war machinery. This fact was recognized by the Hoover Commission when it recommended a reorganization of the Department of State and the creation of the office of staff secretary.[29]

On May 7, 1947, the Department of State took a very significant step by establishing, in the office of the under secretary of state, the policy planning staff "to assure the development, within the department, of long-range policy which will serve as a framework for program-planning and a guide for current policy decisions and operations."[30]

The planning staff works only on a few important long-range policies. Obviously it can do no more. Its role as a coordinator, working with the military services and the staff of the National Security Council, is extremely important.

There is no simple answer as to how foreign policy is made. "The formation of foreign policy in any country is determined by a variety of factors. The constitutional requirements and the political institutions shape the mould in which it is formed. National interests, public opinion, and the personalities which the play of domestic politics bring to influential positions control the direction and application of policy.[31]

Policies may be formulated by the high level policy planning group in the Department of State, or they may be developed by the National Security Council, top advisory body to the President. More frequently policy will find its source in the lower echelon inter-agency committees. Or foreign policy may be formulated by an individual officer on a "political" desk of the Department of State or an official in the "economic" or other "functional" unit of the department. Or foreign policy may have its origin in some other agency of government.

By and large most decisions in the field of foreign policy are made by the "operating officials" in the performance of their regular daily duties, such as the drafting of answers to queries received from diplomatic missions abroad. The importance of the day-to-day operating decisions in the building of patterns of action into policy must never be overlooked. In the end, the men who draft the cables play a very important role in shaping American foreign policy.

Secretary of State Charles Evans Hughes once pointed out that "foreign policies are not built upon abstractions. They are the result of practical conceptions of national interest arising from some immediate exigency or standing out vividly in historical perspective."

Foreign policy is but a part of national policy. Its formulation is affected by the compromises inherent in the political process. Foreign policy decisions must often be made not on the basis of "what is most desirable" but as a result of careful appraisal of "what is possible."

The Congress, the President, the Cabinet, the Department of State, other departments and agencies, the military, civilians, pressure groups, the public all make foreign policy. The process is complex; the method is often cumbersome.

[29]See the Reports on *General Management of the Executive Branch* and *Foreign Affairs*. Other recent plans for reorganization are those of General Nelson of 1946 and Assistant Secretary of State John E. Peurifoy of 1948.

[30]*Department of State Bulletin*, May 18. 1947 (Vol. 16) p. 1007; see also Robert T. Elson, "The New Strategy in Foreign Policy," *Fortune*, December, 1947, and Ware Adams, "The Policy Planning Staff," *The American Foreign Service Journal*, September, 1947.

[31]Norman J. Padelford, *Current Readings on International Relations No. 4*, (1948), p. 170.

Please Print Plainly!

(Continued from page 18)
quote a few (condensed) lines from an article, written by James W. Fairchild and William H. Harrison, Jr., two instructors at Illinois Tech, for the March 1949 issue of the *Illinois Tech Engineer*.

"There are indications that a wave of discontent is mounting among the professional employees in industry. The C.I.O. and the A.F. of L. are laying the groundwork for intensive campaigns. In a large Chicago plant, in less than three months, a unit that was being formed had signed up more than one third of the eligible engineers. These men certainly must have many concrete grievances to prompt them to act so swiftly.

"It is interesting to note that most of the grievances felt by these engineers are not primarily concerned with money. Organizational literature shows a preoccupation first with attempts to improve the standards of the profession and second with drives for higher pay.

"If management is willing to call its engineers "professional people", is it also ready to treat them in a professional manner? Is it, for instance, necessary that these "professional people" punch a time clock?"

To which I may add: and is it necessary that they fill out application blanks which are apt to offend their personal dignity and professional pride?

ILLINOIS TECH ENGINEER Vol 14 1948-49.

Author Index.

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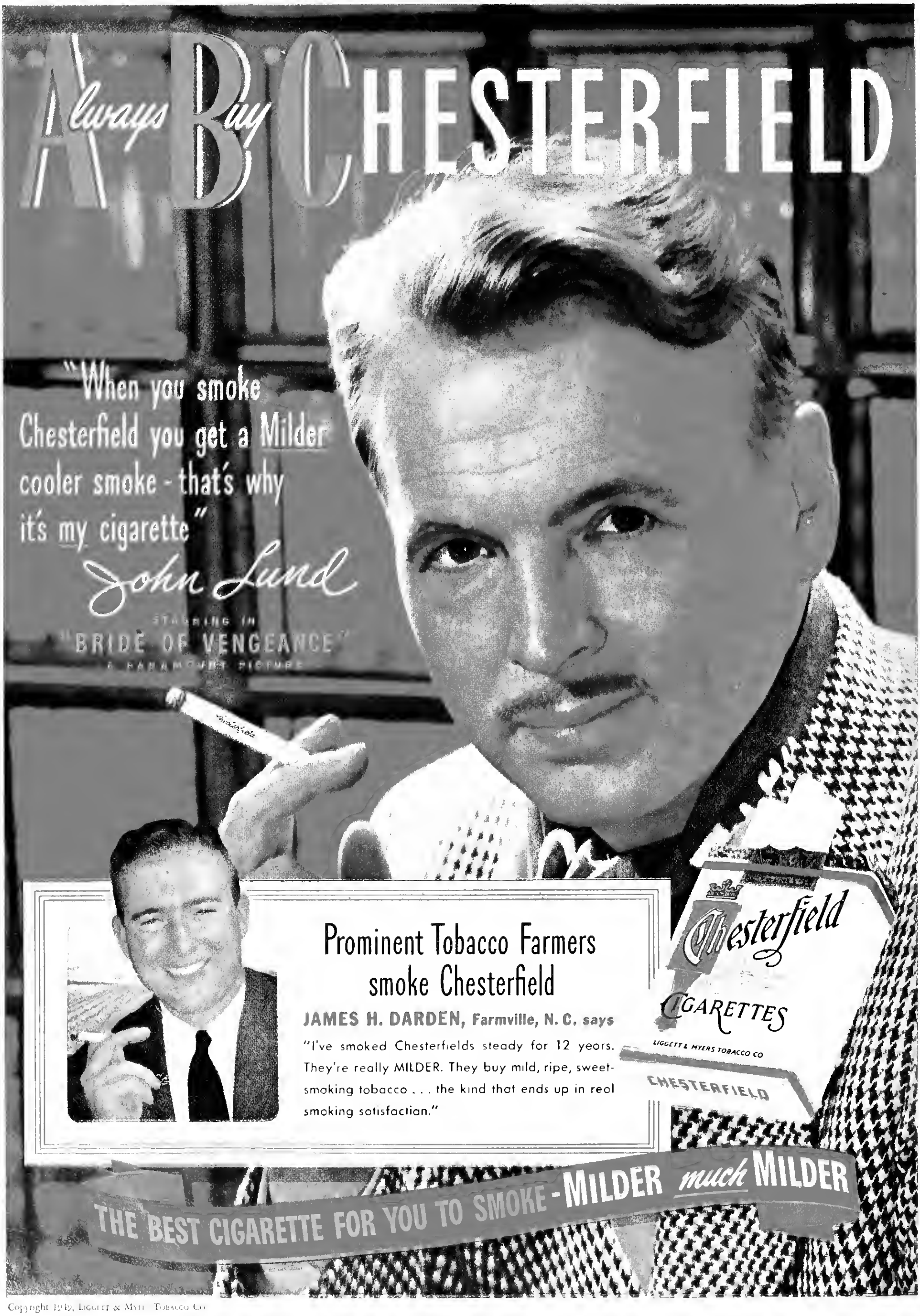

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